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# U.S. Army Center for Health Promotion and Preventive Medicine

## PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99

RESIDENTIAL EXPOSURE FROM INHALATION OF  
AIR EMISSIONS FROM THE M485A2  
155-MILLIMETER ILLUMINATION ROUND  
DEPARTMENT OF DEFENSE IDENTIFICATION CODE: D505



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## ***U.S. Army Center for Health Promotion and Preventive Medicine***

*The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.*

*Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.*

*On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.*

*The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:*

- ★ *Integrity is the foundation*
- ★ *Excellence is the standard*
- ★ *Customer satisfaction is the focus*
- ★ *Its people are the most valued resource*
- ★ *Continuous quality improvement is the pathway*

*This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.*

## REPORT DOCUMENTATION PAGE

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REPLY TO  
ATTENTION OF

MCHB-TS-EHR

PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99  
RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS  
FROM THE M485A2 155-MILLIMETER ILLUMINATION ROUND

### EXECUTIVE SUMMARY

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This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the M485A2 155-millimeter illumination round during training exercises. Pyrotechnics, such as the M485A2 155-millimeter illumination round, are used by the military for signaling, obscuring, and illuminating during training and combat. Study results showed that no health impacts are expected, to the hypothetical resident, from inhalation of the air emissions from the M485A2 155-millimeter illumination round.

To conduct this study, air emissions from the M485A2 155 mm illumination round were collected in a test chamber (Bang Box) at the Dugway Proving Ground, Utah. This information was then used in an air dispersion model to determine ambient air concentrations at a location downwind from the site where the M485A2 155-millimeter illumination round was activated. Since the training facility in this study is hypothetical, the air model used assumptions that provided conservative estimates of air concentrations.

Modeled air concentrations were combined with exposure information (e.g., number of exposures per year) to estimate the amount of substances the hypothetical resident breathes. This intake was combined with the substance's health information, which was obtained from agencies such as the U.S. Environmental Protection Agency, to determine if there is a potential for health risks from inhalation of these substances.

The health risk study included both long-term (30 years) and short-term (15-minute or 1-hour) exposures to modeled substance concentrations. Study results showed no potential for health risks to the hypothetical resident from inhalation of air emissions from the M485A2 155-millimeter illumination round.

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## LIST OF ACRONYMS

AEC	U.S. Army Environmental Center
AEGL	Acute Exposure Guideline Levels
AIHA	American Industrial Hygiene Association
ATV	Acute Toxicity Value
DODIC	Department of Defense Identification Code
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guidelines
HBSL	Health-Based Screening Level
NAAQS	National Ambient Air Quality Standards
NAC/AEGL	National Advisory Committee for Acute Exposure Guideline Levels
NEW	Net Explosive Weight
NO <sub>x</sub>	Nitrogen Oxide
OEL	Occupational Exposure Limit
PM <sub>10</sub>	Particulate Matter under 10 micrometers in size
PRG	Preliminary Remediation Goals
RBC	Risk-Based Concentration
RfC	Reference Concentration
TEEL	Temporary Emergency Exposure Limits
TPCWG	Total Petroleum Criteria Working Group
TSP	Total Suspended Particulates
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine

PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99  
RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE  
M485A2 155-MILLIMETER ILLUMINATION ROUND

1. PURPOSE

This document presents the evaluation of the potential for human health effects to offsite residents breathing air emissions following use of the M485A2 155-millimeter illumination round during training exercises.

2. AUTHORITY

Memorandum, U.S. Army Environmental Center, 4 June 1999, Subject: Pyrotechnics Risk Assessment.

3. REFERENCES

See Appendix A.

4. BACKGROUND

a. PYROTECHNICS AND THEIR USE

The term pyrotechnics is derived from the Greek words "pyr" and "technē" meaning fire and art, respectively. This term is often used interchangeably with the term firework. Examples of pyrotechnics include distress flares and fireworks for commercial (e.g., public displays) and consumer (e.g., sparklers) use. Every year, during Independence Day and New Year's Eve, fireworks are used for public displays across the country. During the 1998 Olympic Wintergames in Nagano, Japan, almost 5000 pyrotechnics were launched during a firework display which lasted for 8 minutes.

The military uses pyrotechnics for four purposes: 1) as a method of communication through the use of signals, 2) to produce smoke to reduce enemy effectiveness, 3) for illuminating the field, and 4) to simulate battle conditions during training exercises. Pyrotechnics play an important role in both military training and combat. Therefore, it is important that our troops are adequately trained to use them properly.

b. WHAT IS THE M485A2 155-MILLIMETER ILLUMINATION ROUND?

The M485A2 155-millimeter illumination round (M485A2) is a type of pyrotechnic used mainly to light up the field at night or during times where visibility is poor. It is a relatively large device, weighing about 93 pounds when loaded (Reference 1).

c. USE OF THE M485A2 155-MILLIMETER ILLUMINATION ROUND

The M485A2 is fired from a 155 mm howitzer, a cannon used for firing projectiles to high elevations. A propellant charge carries the round to a height of about 1800 feet. Once the M485A2 has reached the appropriate height for functioning, a canister containing the illuminant is expelled. The illuminant activates a few seconds later and falls slowly to the ground as the main parachute opens. The bright light provided by the illumination charge lasts for about two minutes.

d. ASSESSMENT SUMMARY

The approach for this study consisted of two main parts: air dispersion modeling and exposure assessment. These are briefly discussed in the paragraphs below. Sections 5-7 present a more explicit discussion of the methodology used for this study.

Data generated in the "Bang Box" at the Dugway Proving Ground, Utah (Reference 2), were used with an atmospheric dispersion model (Reference 3) to estimate the average concentrations that would be experienced by an offsite resident. Since this study is designed to provide results that would be applicable to most Army training facilities, the training area used in this evaluation was a hypothetical one. In addition, air modeling parameters were selected to mimic worst-case conditions.

The exposure assessment included calculations of time-averaged concentrations for both long-term (chronic) and short-term (acute) exposures. For the purpose of this study, air concentrations were averaged over 30 years for chronic exposures and 1 hour or 15 minutes for acute exposures. These concentrations were compared to chronic health-based screening levels (HBSLs) established by the U.S. Environmental Protection Agency (EPA) or acute toxicity values (ATVs) established by selected agencies depending on the exposure duration (i.e., 30 years versus 1 hour or 15 minutes). If the chronic or acute concentrations ( $C_{\text{chronic}}$  and  $C_{\text{acute}}$ ) were greater than these screening levels, further analysis would be warranted to determine the potential for health effects. It should be noted that concentrations greater than the screening levels do not indicate an onset of health effects, but rather the potential for such.

5. METHODS AND DATA COLLECTION

a. EMISSION FACTORS

The air modeling emission rates were derived from the pyrotechnics emission studies conducted at Dugway Proving Ground, Utah (Reference 2). These studies sampled air emissions from the firing of weapons and/or munitions

used in training. The purpose of this sampling was to identify and quantify the air emissions. The data provided by Dugway Proving Ground included the identification of the munitions item and compounds sampled, net explosive weight (NEW) of the item, vertical and horizontal dimensions of the plume from thermograph data and video, and compound emission factors. This data is included in the tables in Appendix B.

b. AIR MODEL

(1) BACKGROUND

Air dispersion models are available to mathematically simulate atmospheric conditions and behavior to predict downwind concentrations caused by emissions from various sources. However, specific models are not available to estimate the dispersion of emissions from the use of munitions in training. The emissions from munitions used in training result in ambient concentrations of compounds at various locations. The magnitude and location of these concentrations depend on many factors including the amount and type of emissions, the behavior of the source, and meteorological conditions. Based on the evaluation of air dispersion models for military munitions, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) recommended using the Integrated PUFF (INPUFF) model to estimate the dispersion of emissions from mobile pyrotechnics (Reference 4).

(2) MODEL DESCRIPTION

The INPUFF Model was developed to simulate dispersion from instantaneous or semi-continuous point sources. This Gaussian-integrated puff model is capable of addressing a puff type release over short periods of time, and computations can be performed for a single point source for multiple receptors. The algorithm used to calculate concentrations uses a vertically uniformed wind direction (with no chemical reaction) to compute the contribution of each puff at a receptor for each time step/interval.

(3) ASSUMPTIONS

Some assumptions were made to best represent the M485A2 in the air model. These assumptions were as follows:

- (a) For unconventional sources with no physical stack dimensions, the initial horizontal and vertical dispersion values ( $\sigma_y$  and  $\sigma_z$ ) of the released puff were used to define the dimensions of the puff. Therefore, plume rise and formation were not determined by characterizing flue gas exit velocity and stack diameter, as they are with conventional point sources. The initial dimensions were set to values measured during Dugway Proving Ground

testing and the dispersion of the initial cloud was modeled. The physical dimensions, including height and length of the puff or cloud, were estimated from the thermograph data recorded at every time step. The data also included minimum, mean, and maximum temperature readings during the duration of the emission test and were used to define the flue gas exit temperature.

(b) The worst-case release scenario analysis was performed using EPA Risk Management Program Guidance (Reference 5). This guidance includes tables for estimating the footprint of chemical releases. These guidelines were intended to inform emergency responders of the worst possible accidental release, but not necessarily the most likely. The EPA has defined most default conditions for meteorological modeling parameters. Table 1 lists the parameters that were used in the model.

**TABLE 1. AIR MODEL INPUT PARAMETERS**

<b>MODEL PARAMETERS</b>	
Number of meteorological periods (NTIME)	1
Duration of each meteorological period (ITIME)	400 s
Number of updates to the source (NSRCDS)	100 per source
Duration between each source update/time-step (ISUPDT)	4 s
Total time modeled/Simulation Period (NTIME * ITIME)	400 s
<b>SOURCE PARAMETERS</b>	
Source/Stack Diameter	1.5 m for sources (1-5).
Source/Stack Height	See Table 3.
Source Exit Temperature	Varied for each source every time step (degrees Kelvin (K))
Exit Velocity	NA
Emission Rate	1 g/s
Initial horizontal dispersion ( $\sigma_y$ )	Varied for each source every time step (4 s)
Initial vertical dispersion ( $\sigma_z$ )	Varied for each source every time step (4 s)
<b>WORST CASE METEOROLOGICAL PARAMETERS</b>	
Wind Speed	1 m/s
Atmospheric Stability	Category F
Wind Direction	270° degrees West
Ambient Temperature	293 degrees Kelvin (K) or 68 °F
Worst case Receptor Location	100 m directly downwind

- (c) The resident used in this study was assumed to be directly downwind from the source. The meander of the puff is a major factor when estimating concentrations at given locations downwind from the source. Assuming that the resident is directly downwind from the source is the same as assuming that there is no puff meander and provides the most conservative modeled concentrations.
- (d) Emissions were assumed to be emitted from a single representative source. This method is more conservative than the assumption that several individual sources are emitted over an area. The EPA guidance document "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources" (Reference 6) recommends merging parameters for multiple sources that are within 100 meters of each other. For the purposes of this study, an event was defined as the activation of one item. For more information on how this output data was used to evaluate exposure, see Section 5c (Exposure Assessment).
- (e) Figure 1 provides a schematic diagram of the trajectory of the M485A2. The data for Figure 1 were obtained from References 1 and 7. The performance data provided estimated travel times (t), and velocities (v) at which the items ascend and descend.

#### (4) GENERAL METHODOLOGY

- (a) The INPUFF model determined the amount of time it would take for the puff to pass over a location 100 meters (m) downwind. The released puff migrated at the constant wind speed of one meter per second (1 m/s) downwind from the point of activation. Assuming a distance of 100 m and a travel velocity of 1 m/s, it took 100 s for the center of each puff to reach this distance.
- (b) The model was run with a total runtime of 400 seconds (s) to ensure that the total mass of the puff had passed the receptor. Since the model is capable of providing 100 updates (puffs), each intermediate puff was assumed to be 400 s divided by 100 updates, which is 4 s.
- (c) The receptors were placed at a minimum distance of 100 m and to a distance of 400 m. The receptor heights used were at both ground level and at breathing height (1.5 m). The receptor with the most conservative output (i.e., highest concentrations) was used for to estimate the potential for health risk from inhalation. In the case of the M485 series, under the modeled circumstances, the most conservative receptor was at a distance of 250 m and at breathing height.

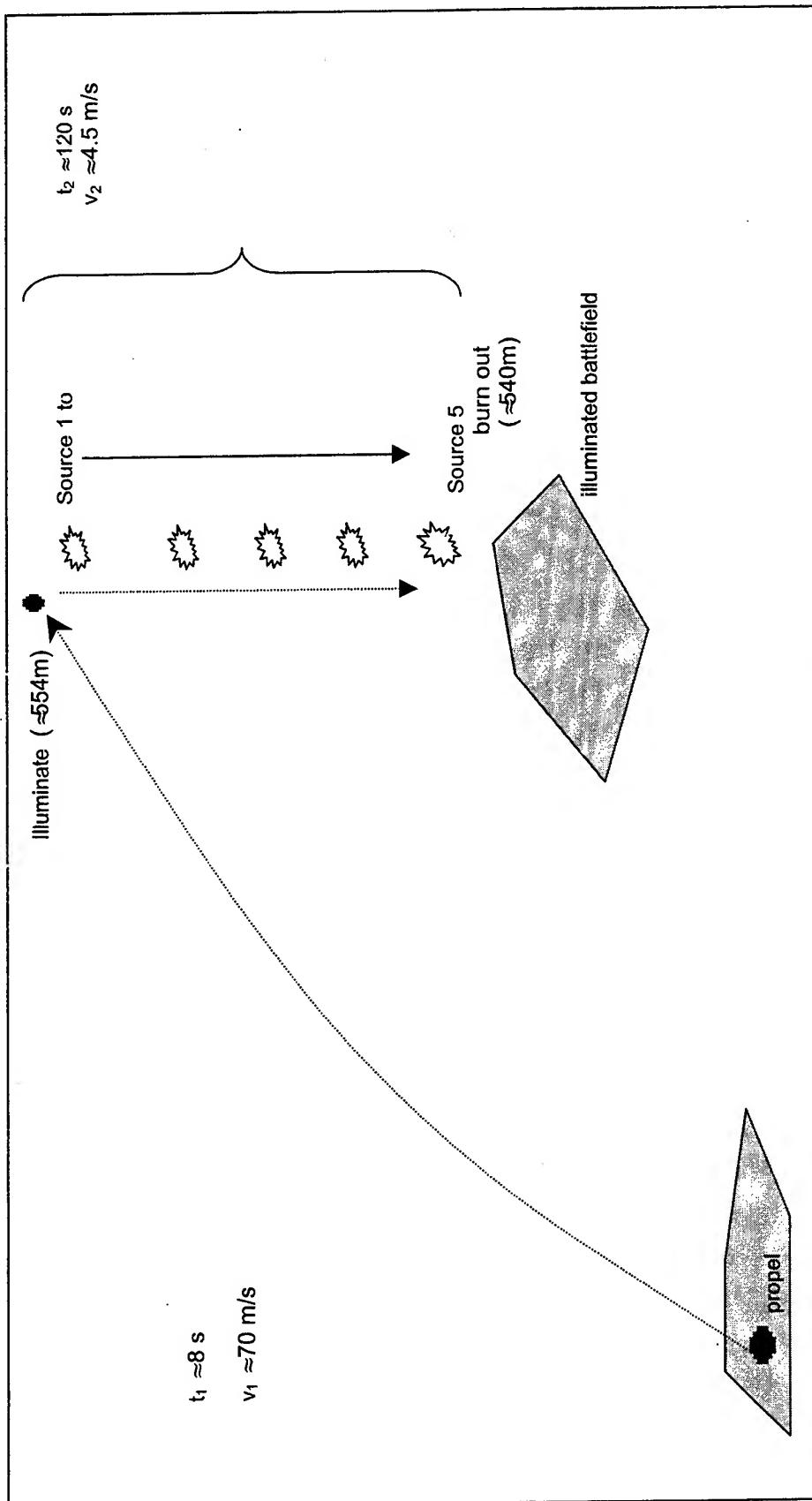


FIGURE 1. SCHEMATIC DIAGRAM OF THE TRAJECTORY OF THE M485A2

(d) The illumination round was modeled as 31 different sources with different source parameters for each time step. A different release height with varying release temperatures was used for each source. Table 2 illustrates how the emissions for the 155mm illumination round were separated into five different point sources and the emissions for each source were staggered over a burn time of 124 s.

**TABLE 2: 155MM ILLUMINATION ROUND (M485 SERIES) SOURCE SIMULATION**

Source No.	Height (m)	Unit Emission Rate of 1g/s per time step
1	554.0	0 to 4 s
2	536.0	4 to 8 s
3	518.0	8 to 12 s
4	500.0	12 to 16 s
5	482.0	16 to 20 s
6	464.0	20 to 24 s
7	446.0	24 to 28 s
8	428.0	28 to 32 s
9	410.0	32 to 36 s
10	392.0	36 to 40 s
11	374.0	40 to 44 s
12	356.0	44 to 48 s
13	338.0	48 to 52 s
14	320.0	52 to 56 s
15	302.0	56 to 60 s
16	284.0	60 to 64 s
17	266.0	64 to 68 s
18	248.0	68 to 72 s
19	230.0	72 to 76 s
20	212.0	76 to 80 s
21	194.0	80 to 84 s
22	176.0	84 to 88 s
23	158.0	88 to 92 s
24	140.0	92 to 96 s
25	122.0	96 to 100 s
26	104.0	100 to 104 s
27	86.0	104 to 108 s
28	68.0	108 to 112 s
29	50.0	112 to 116 s
30	32.0	116 to 120 s
31	14.0	120 to 124 s

\*The emission rates return to 0 g/s for all time steps not shown in the table. Note: the location of each of the sources with z representing the base elevation was modeled at (x, y, z)=(0,0,0)

## (5) USE OF MODEL OUTPUT

The concentrations provided by the INPUFF model are based on a unit emission rate of 1 g/s from an emission source and does not represent any pollutant-specific concentration from the use of pyrotechnics. The relationship between the emission rate and predicted concentration is linear. Therefore, the ratio of the predicted concentration to the unit emission rate was multiplied by each pollutant-specific emission rate to provide pollutant-specific concentrations.

## (6) DETERMINATION OF POLLUTANT-SPECIFIC EMISSION RATES

(a) The actual emission rate per item ( $ER_1$ ) for each pollutant was calculated using the following equation:

$$ER_1 = \frac{M \cdot CV}{t} \quad \text{Equation 1}$$

where:

$ER_1$  = emission rate for one item (g/(item\*sec))  
 $M$  = total mass (lb) of pollutant emitted per item (lb/item)  
 $CV$  = conversion factor (453.59 g/lb)  
 $t$  = release duration in seconds (s) (References 1, 7)

**Example 1**  
**Sample Calculation Using Equation 1\*:**

$$ER_1 = \frac{(2.598E + 00)(453.59)}{(124)}$$

$$= 9.505E+00 \text{ g/(s*item)}$$

\*Calculation for total suspended particulates (TSP). Averaged adjusted emission factor of TSP in lb/item was obtained from Appendix B.

(b) The pollutant emission rate for an event ( $ER_{EV}$ ) for each pollutant was calculated using the estimated number of potential items used in a training event according to the following equation:

$$ER_{EV} = ER_1 \cdot I \quad \text{Equation 2}$$

where:

$ER_{EV}$  = emission rate for the estimated number of potential items used in a training event (g/s)

$ER_1$  = emission rate for one item (g/(item\*sec))

$I$  = items per event (item/event)

**Example 2**  
**Sample Calculation Using Equation 2\*:**

$$ER_{EV} = (9.505E + 00)(1)$$

$$= 9.505E+00 \text{ g/s}$$

\* Calculation for TSP

(c) Pollutant-specific ambient concentrations for an event (CONC) were calculated using the following equation:

$$CONC = ER_{EV} \cdot \frac{UC}{ER_{unit}} \quad \text{Equation 3}$$

where:

CONC = pollutant concentration based on the number of items used in a training event (g/m<sup>3</sup>)

$ER_{EV}$  = emission rate for the estimated number of items used in a training event (g/s)

$ER_{unit}$  = unit emission rate as used in the model (g/sec)

UC = concentration based on the unit emission rate (g/m<sup>3</sup>)

**Example 3**  
**Sample Calculation Using Equation 3\*:**

$$CONC = (9.505E + 00) \frac{(1.191E - 05)}{(1)}$$

$$= 1.132E-04 \text{ g/m}^3$$

\* Calculation for TSP (for receptor at 250 meters downwind)

c. EXPOSURE ASSESSMENT

(1) EXPOSURE ASSUMPTIONS

(a) Exposure assumptions were selected using a typical use scenario for the M485A2. This use scenario was developed based on consultation with the U.S. Army Environmental Center's (AEC) senior training advisor (References 8, 9). The frequency of use of the M485A2 was required to determine how much substance an offsite resident would be exposed to in the time period of interest (i.e., acute or chronic exposure). For the purposes of this study, a training scenario is defined as a day or session of training whereas a training event is defined as a single use of pyrotechnics. A training scenario may consist of multiple training events. Table 3 summarizes the specific assumptions used to determine how often the M485A2 is used during a training scenario.

TABLE 3: FREQUENCY OF USE FOR THE M485A2

Parameter	Value Used
Number of items used per training scenario	10
Frequency of use	3 in 10 minutes
Time between each use	3 minutes
Number of scenarios per year	5

(b) For the chronic and acute evaluations, air emissions were estimated based on the activation of one item per event. The puff that resulted from this event was then modeled to a point 250 meters downwind. Since the unit emission rate was calculated using a runtime of 400 seconds, each event was also assumed to last 400 seconds (or 6.67 minutes)

(2) TIME-AVERAGING

For the chronic assessment, time-averaged concentrations were calculated using the EPA's default residential exposure duration of 30 years (this value assumes that the resident spends 30 years at the same residence). This was done to derive concentrations that would be consistent with the exposure duration used by the EPA so that estimated substance concentrations could be compared to their respective health-based screening levels.

In this evaluation, training scenarios occur five times a year (References 8, 9). Using the default residence time established by the EPA, the assumption was made that someone could be exposed to five training scenarios per year for 30 years.

(a) The average daily concentrations were calculated using Equation 4. In this study, the air concentrations were estimated to be higher at a distance 250 meters (as opposed to 100 meters used in other studies) downwind from the site of activation. Since this evaluation is intended to be a generic study, the concentrations at this distance were used to evaluate potential health effects. The average modeled concentrations were multiplied by ten to account for all ten items that could potentially be used in one training day. An example calculation of Equation 4, using TSP, is shown below. It should be noted that the average modeled concentration was converted from  $\text{g/m}^3$  to  $\mu\text{g/m}^3$  before it was used in Equation 4.

$$C_d = \frac{\text{CONC} \cdot ET \cdot EF_{\text{day}}}{1440} \quad \text{Equation 4}$$

where:

$C_d$  = average daily concentration ( $\mu\text{g/m}^3$ )  
CONC = average modeled concentration ( $\mu\text{g/m}^3$ )  
 $ET$  = exposure time (minutes/event)  
 $EF_{\text{day}}$  = exposure frequency (events/day)  
1440 = unit conversion from minutes to day

**Example 4**  
**Sample Calculation Using Equation 4:**

$$C_{d(\text{TSP})} = \frac{(1.132E + 02)(6.67)(10)}{1440}$$
$$= 5.243E+00 \mu\text{g/m}^3$$

The averaged modeled concentration (CONC) for TSP was obtained from Appendix B. The exposure parameters were obtained from Table 4.

(b) Average chronic concentrations were calculated using Equation 5. The resulting concentration ( $C_d$ ) from Equation 4 was used in Equation 5 to determine the average chronic concentrations. Example 5 shows how this calculation was performed.

$$C_{\text{chronic}} = \frac{C_d \cdot EF_{\text{year}} \cdot ED}{AT} \quad \text{Equation 5}$$

where:

$C_{chronic}$  = average chronic concentration ( $\mu\text{g}/\text{m}^3$ )  
 $C_d$  = average daily concentration ( $\mu\text{g}/\text{m}^3$ )  
 $EF_{year}$  = exposure frequency (days/year)  
 $ED$  = exposure duration (years)  
 $AT$  = averaging time (days)  
 (for carcinogenic endpoint,  $AT = 70$  years  $\times 365$  days;  
 noncarcinogenic endpoint,  $AT = ED \times 365$  days)

**Example 5**  
**Sample Calculation Using Equation 5:**

$$\begin{aligned}
 C_{chronic(TSP)} &= \frac{(5.243 E + 02)(5)(30)}{(30)(365)} \\
 &= 7.18E-02 \mu\text{g}/\text{m}^3
 \end{aligned}$$

The average daily concentration was calculated as shown in Example 4. The exposure parameters were obtained from Table 4.

(c) This study assumed that the same person would be exposed 5 days every year for 30 years. Table 4 lists the exposure parameters used in Equations 4 and 5.

**TABLE 4: EXPOSURE PARAMETERS USED TO DETERMINE TIME-AVERAGED CHRONIC AIR CONCENTRATIONS**

Exposure Parameter	Value Used
Exposure Time (ET)	6.67 minutes/event
Exposure Frequency ( $EF_{day}$ )	10 events/day <sup>a</sup> 10 events/hr <sup>b</sup>
Exposure Frequency ( $EF_{year}$ )	5 days/year
Exposure Duration (ED)	30 years

<sup>a</sup> Ten events used for the chronic evaluation since the air model was run for the activation of one item and ten items can be used in one day (See Table 3).  
<sup>b</sup> Ten events also used for the acute evaluation since ten items can be used within one hour.

(d) Unlike the chronic evaluation, guidance for evaluating acute exposures is not currently available. However, due to the nature of the use of pyrotechnics and short duration of the concentration plume, acute exposures cannot be overlooked. For the purpose of this study, acute exposure is defined as a 1-hour or 15 minute exposure. The 1-hour or 15

minute acute exposure averaging times allow for comparison with guidelines developed specifically for emergency planning purposes (see discussion on acute toxicity below). This is a conservative assumption since the air model indicated that the hypothetical resident is not expected to be exposed for more than 10 minutes to the concentration plume following activation of three M485A2s.

(e) The average acute concentrations were computed using Equation 6. The exposure frequency is based on the number of events per hour or 15 minutes depending on the guideline used for comparison. Example 6 contains a sample calculation of this equation. Since TSP has no acute toxicity value, an acute concentration was not determined for this substance. Therefore, nitrogen oxide (NO<sub>x</sub>) was used for the example calculation.

$$C_{acute} = \frac{CONC \cdot ET \cdot EF_{hour}}{60} \quad \text{Equation 6}$$

where:

$C_{acute}$  = average acute concentration ( $\mu\text{g}/\text{m}^3$ )  
CONC = average modeled concentration ( $\mu\text{g}/\text{m}^3$ )  
ET = exposure time (minutes/event)  
 $EF_{hour}$  = exposure frequency (events/hour)  
60 = unit conversion, 60 minutes/hour

**Example 6**  
**Sample Calculation Using Equation 6:**

$$C_{acute(NO_x)} = \frac{(3.812E + 00)(6.67)(10)(1 / 0.25)}{60}$$
$$= 1.69E+01 \mu\text{g}/\text{m}^3$$

The average acute concentration (CONC) was obtained from Appendix B. For NO<sub>x</sub>, the acute toxicity value is based on a 15-minute exposure (TEEL-1). Therefore, the acute concentration was adjusted so that  $C_{acute}$  can be compared with its toxicity value.

**d. TOXICITY ASSESSMENT**

The potential for health risks was determined by comparing time-averaged air concentrations to health-based screening levels, which are developed from a

substance's known toxicity. These toxicity values typically include different levels of safety factors depending on the level of confidence of the critical study. Appendix C contains a table of screening values used for the chronic and acute evaluations.

### (1) CHRONIC ASSESSMENT

- (a) The chronic assessment was evaluated using a screening approach. Using this method, a substance's estimated time-averaged air concentration was compared to its HBSL. If this ratio was less than one, no further analysis was required. This approach is conservative because the exposure assumptions used by the EPA, to establish HBSLs, assume that the resident is exposed for 350 days per year (assuming 2 weeks vacation per year). Since the training scenarios, in which the M485A2 is used, are not expected to exceed 5 days per year, HBSLs specific to this study (if they were developed) would likely be higher.
- (b) HBSLs were obtained from the EPA, primarily from Region 3 and Region 9 (References 10, 11). To ensure that the most recent information was used, the Internet sites of both regions were checked. Although the general approach used by both Region 3 and Region 9 is the same, the exposure assumptions differ enough so that final recommended screening levels can vary to a certain degree. In both methods a substance's HBSL is selected using the toxicity endpoint that derives a lower concentration. For example, if a substance has a known systemic toxicity and is a carcinogen, concentrations were calculated using both toxicity information. The lower concentration was then selected as the recommended screening level to maintain a conservative approach.
- (c) A hierarchy was developed in order to quantitatively evaluate for as many of the identified substances as possible. Since the methodology used by Region 9 results in lower HBSLs than Region 3, the Region 9 preliminary remediation goals (PRGs) were used first. Region 3's risk-based concentrations (RBCs) were only used when a PRG was not available. The only exception was for chromium (VI) [Cr (VI)] where Region 9 used a carcinogenic toxicity value that was seven times greater than the EPA's recommended value to develop its screening level for inhalation exposure (Reference 12). Since the EPA does not advocate the application of this multiplication factor, the RBC for Cr (VI) was used instead of the PRG.
- (d) Some substances have neither PRGs nor RBCs because they have their own set of regulatory standards. Under the Clean Air Act, the EPA is required to establish National Ambient Air Quality Standards (NAAQS) (Reference 13) for several substances considered harmful to public health and the environment. Currently, NAAQS are available for six substances, of which carbon monoxide, nitrogen dioxide, lead, sulfur dioxide, and

particulate matter < 10 micrometers (PM<sub>10</sub>) have been detected in the M485A2 Bang Box study. The NAAQS for the longer averaging time were used for the chronic evaluation. Depending on the substance, this can range from an 8-hour average to an annual average. In addition, since the majority of the measured total suspended particulates (TSP) were PM<sub>10</sub> (Reference 2), the NAAQS for PM<sub>10</sub> was used to evaluate the potential for health effects from exposure to TSP.

**Example 7**

**Sample Calculation Comparing a Substance's Estimated Chronic Concentration to Its HBSL:**

$$\frac{C_{\text{chronic(TSP)}}}{\text{HBSL}} = \frac{7.18E - 02}{5E + 01}$$
$$= 1.44E-03 \text{ (or 0.001)} < 1$$

Note that HBSL is the health-based screening level of TSP. For TSP, the HBSL is based on the NAAQS. In this case, the resulting ratio is three orders of magnitude less than 1.

- (e) Many petroleum hydrocarbons were detected but do not have specific screening levels. Therefore, the approach recommended by the Total Petroleum Criteria Working Group (TPHCWG) (Reference 14) was adopted to evaluate petroleum hydrocarbon mixtures. Based on the working group's assessment of various hydrocarbons, they recommended that mixtures be separated according to a substance's number of carbons and its chemical class (i.e., aliphatic or aromatic<sup>1</sup>). Generally, as a substance's carbon number increases, its molecular weight increases and it is therefore, not a substance of concern via inhalation. The working group also concluded that aromatic hydrocarbons tend to be more toxic than aliphatic hydrocarbons (Reference 14).
- (f) Table 5 tabulates the inhalation toxicity values used to evaluate exposure to petroleum mixtures. To be consistent with the methodology used in this study, the reference concentrations (RfCs) were converted to PRGs using Region 9 assumptions. The resulting PRGs are included in Table D-4 in Appendix D.

<sup>1</sup> Aliphatic hydrocarbons are hydrocarbons in which the carbon atoms are joined by single covalent bonds consisting of two shared electrons (e.g., butane). Aromatic hydrocarbons have ring structures (e.g., benzene) (Reference 15).

**TABLE 5: SUMMARY OF RfCs USED FOR PETROLEUM HYDROCARBONS  
(Reference 14)**

Carbon Range	Aromatic Inhalation RfC (mg/m <sup>3</sup> )	Aliphatic Inhalation RfC (mg/m <sup>3</sup> )
C <sub>5</sub> – C <sub>6</sub>		18.4
C <sub>&gt;6</sub> – C <sub>8</sub>		
C <sub>&gt;7</sub> – C <sub>8</sub>	0.4	
C <sub>&gt;8</sub> – C <sub>10</sub>		
C <sub>&gt;10</sub> – C <sub>12</sub>	0.2	1.0
C <sub>&gt;12</sub> – C <sub>16</sub>		
C <sub>&gt;16</sub> – C <sub>21</sub>	NA	NA
C <sub>&gt;21</sub> – C <sub>35</sub>		

NA = not applicable for high molecular weight TPHs (C<sub>>16</sub>) because compounds in this carbon range are not volatile and therefore, inhalation is not a pathway of concern.

## (2) ACUTE ASSESSMENT

- (a) As previously indicated, an acceptable method for assessing acute health effects is not currently available. It was not until recently that EPA guidance addressed the need to evaluate acute health effects from inhalation (Reference 16). Even then, acute toxicity data for risk assessment purposes were not readily available. The EPA recognized this deficiency and spearheaded the National Advisory Committee for Acute Exposure Guideline Levels for Hazardous Substances (NAC/AEGL Committee). However, AEGLs are currently available for only a handful of substances.
- (b) To circumvent this problem, several state regulatory agencies have suggested that guidelines developed for emergency purposes be used in the interim. Although suggestions have been made to use occupational exposure limits (OELs) by applying additional safety factors (References 17, 18), OELs were not used in this study because they introduce even more uncertainty than the use of emergency guidelines. OELs are designed to protect the workplace environment and assume 8 hours a day, 5 days a week exposures. By definition, these exposures are more chronic than acute.
- (c) In comparison, emergency planning guidelines are more appropriate because they are typically developed exposures of 1-hour or less. In addition, safety factors may also have been included depending on the agency that develops these guidelines, so that the values would be protective of the general population.
- (d) Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA) (Reference 19) and the

Temporary Emergency Exposure Limits (TEELs) developed by the U.S. Department of Energy (DOE) (Reference 20) were used for this study; specifically the ERPG-1s and the TEEL-1s. Since TEEL-1s are intended for 15-minute exposures, air concentrations compared to TEELs were averaged over a 15-minute period as opposed to 1-hour in this assessment. The AIHA defines ERPG-1 as follows:

"The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

The DOE defines TEEL-1 as follows:

"The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

(e) For this study, ERPGs were selected prior to a substance's TEEL because they are vigorously reviewed before they are published whereas the TEELs are not. Example 8 shows a sample calculation of how a substance's estimated acute concentration is compared to its acute toxicity value.

**Example 8**

**Sample Calculation of Comparing a Substance's Estimated Acute Concentration to Its Acute Toxicity Value:**

$$\frac{C_{acute(NO_x)}}{ATV} = \frac{1.69E + 01}{2.7E + 05}$$
$$= 6.27E-05 \text{ (or 0.00006)} < 1$$

The acute toxicity value available for  $NO_x$  is a TEEL. In this example, the ratio is five orders of magnitude below 1, indicating that further analysis is not necessary.

## 6. RISK CHARACTERIZATION

Appendix D presents results from the M485A2 risk characterization. Note that for some substances, two concentrations were reported because of different analytical test methods (as noted in bold). In those instances, the higher concentration was used.

**a. CHRONIC HEALTH RISK**

The outcome indicated that no chronic health impacts are expected from breathing the air emissions from the M485A2. Since all ratios were below one, no further evaluation was needed.

**b. ACUTE HEALTH RISK**

For the acute analysis, all ratios were below one, indicating that acute health impacts are not expected from breathing the air emissions from the M485A2. Since all ratios for the acute evaluation were below one, no further assessment was needed.

**c. SUBSTANCES WITH NO TOXICITY DATA**

Some substances were not quantitatively evaluated because they do not have established toxicity data. By conducting a semi-qualitative comparison of the concentrations of these substances to similar compounds with available toxicity data, it may be concluded that no potential for health effects would be expected from exposure to these substances.

**d. FACT SHEET**

A copy of the fact sheet submitted to AEC is included as Appendix E. The fact sheet uses the results from this study to summarize health concerns related to inhalation of M485A2 air emissions.

**7. UNCERTAINTY DISCUSSION**

The limitations inherent in modeling and the added conservatism of the evaluation contribute to the uncertainty of the study results. The risk assessment methodology typically includes safety factors that are embedded in the toxicity data to ensure adequate protection of the general population, particularly, susceptible individuals such as the sick, elderly, and children. Table 6 identifies areas of uncertainty associated with this assessment.

**TABLE 6: TYPES OF UNCERTAINTY**

Issue	Uncertainty	Direction of Effect
<b>Modeling</b>		
Modeled versus real-time sampling	The air concentrations in this study were modeled. Actual air concentrations taken from the field may be higher or lower.	Varies
Frequency of use for the M485A2	Actual frequency of use of M485A2s during a training event may be different from those stated in this report.	Varies
Hypothetical resident assumed to be located directly downwind	Unless the area around the training facility is populated, the chances that a person living directly downwind is low.	Overestimates
Use of worst-case meteorological conditions	To ensure that this study is applicable to most training areas, worst-case meteorological conditions were used in the air model.	Overestimates
<b>Exposure Assessment</b>		
Estimating time-averaged concentrations	Actual exposure from the M485A2 is intermittent. If one were to plot a person's exposure profile, the plot would consist of a series of spikes. Since current risk assessment methodology does not allow the evaluation of the potential for health risks as a function of time, a single concentration, averaged over the exposure duration was used. In this study, the exposure durations used were 30 years and 1-hour or 15 minutes.	Varies
Chromium speciation	All chromium was assumed to be present as Cr(VI), which is more toxic than Cr(III).	Overestimates
Comparing estimated concentration to established screening levels	The Region 3 and Region 9 HBSLs were developed using different exposure assumptions than those in this study, resulting in more conservative screening levels.	Overestimates
Screening assessment versus calculating an average daily intake	Calculating an average daily intake allows the use of scenario-specific assumptions. However, unless the ratio of concentration to screening level approaches one, a screening assessment is useful as a first-cut evaluation.	Varies

**TABLE 6: TYPES OF UNCERTAINTY**

Issue	Uncertainty	Direction of Effect
Exposure to other munitions	Other munitions are typically used during the same training event. These items may contain similar or different substances from those detected in the M485A2.	Underestimates
<b>Toxicity Assessment</b>		
Lack of toxicity data	Some substances were not quantitatively evaluated because they have no known toxicity data.	Underestimates
Modifying and uncertainty factors for toxicity data	Modifying factors and uncertainty factors of varying degree are typically applied to toxicological values. These factors are used to conservatively account for extrapolating from animal studies for human health evaluation, and to conservatively account for variation in human populations.	Overestimates

## 8. CONCLUSION

Results indicated that residents who live as close as 100 meters directly downwind from training areas are safe from breathing air emissions from the M485A2. It is believed that the assumptions contained in this analysis are conservative enough to be protective of all the population including the sick, elderly, and children.

## 9. RECOMMENDATIONS

Since the results from this study are intended for a hypothetical training facility, they can vary depending on site-specific conditions. However, because of the conservative assumptions used (e.g., worst-case meteorological conditions, receptor located directly downwind, etc.) it is believed that most site-specific analyses would result in even lower concentrations. Therefore, the results from this evaluation should be applicable to most training facilities unless site-specific conditions vary significantly.

## 10. POINT OF CONTACT

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**APPENDIX A**  
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**APPENDIX B**

**AIR DISPERSION MODELING OUTPUT DATA**

**Table B-1: Air Modeling Output Data for Metals, Particulates, and Miscellaneous Compounds**

		155mm Illumination Round		Items per event (I)		1 Items/hour	
		Average NEW, lb = 6.12		release duration (t):		124 seconds	
		Average Number of Items = 1		Unit Concentration (UC):		1.191E-05 g/m <sup>3</sup> /g/s)	
Compound	Measured Actual Concentration (mg/m <sup>3</sup> )	Measured Background Concentration (mg/m <sup>3</sup> )	Average Adjusted Emission Factor (lb/Item NEW)	Average Adjusted Emission Factor (lb/Item)	Total Mass of Pollutant Emitted (grams/item)	Pollutant Concentration 3 Items (grams/m <sup>3</sup> )	Pollutant Emission Rate 3 Items (g/sec)/item
Particulate					M	CONC	ER <sub>1</sub>
TSP	1.163E+03	ND	4.244E-01	2.598E+00	1.179E+03	1.132E-04	9.505E+00
PM <sub>10</sub>	1.666E+03	ND	6.051E-01	3.705E+00	1.681E+03	1.614E-04	1.355E+01
<b>HCl/Cl<sub>2</sub></b>							
HCl (a)	ND	ND	ND	ND	ND	ND	ND
Cl <sub>2</sub> (a)	2.472E-02	3.022E-02	ND	ND	ND	ND	ND
<b>Dioxin/Furan</b>							
Dioxin TEQ (b)	3.694E-09	1.484E-10	1.307E-12	8.001E-12	3.629E-09	3.486E-16	2.927E-11
<b>CEM System</b>							
Carbon Monoxide (CO)	1.026E+01	2.826E-01	3.943E-03	2.414E-02	1.095E+01	1.052E-06	8.831E-02
Nitrogen Oxide (NOx)	3.619E+01	1.737E-02	1.429E-02	8.750E-02	3.969E+01	3.812E-06	3.201E-01
HCl (a)	4.549E-01	3.844E-01	2.784E-05	1.704E-04	7.731E-02	7.425E-09	6.235E-04
Carbon Dioxide (CO <sub>2</sub> )	1.356E+03	6.585E+02	2.767E-01	1.694E+00	7.684E+02	7.381E-05	6.197E+00
Sulfur Dioxide (SO <sub>2</sub> )	1.064E+00	7.430E-04	4.200E-04	2.571E-03	1.166E+00	1.120E-07	9.406E-03
<b>Particulate-phase Metals</b>							
Aluminum	1.960E-01	NM (c)	7.155E-05	4.381E-04	1.987E-01	1.909E-08	1.602E-03
Antimony	1.150E-02	NM (c)	4.197E-06	2.570E-05	1.166E-02	1.119E-09	9.399E-05
Arsenic	ND	NM (c)	ND	ND	ND	ND	ND
Barium	2.121E-01	NM (c)	7.741E-05	4.740E-04	2.150E-01	2.065E-08	1.734E-03
Beryllium	1.384E-04	NM (c)	5.053E-08	3.094E-07	1.403E-04	1.348E-11	1.132E-06
Cadmium	4.037E-02	NM (c)	1.473E-05	9.022E-05	4.092E-02	3.931E-09	3.300E-04
Chromium	3.776E-03	NM (c)	1.319E-06	8.441E-06	3.829E-03	3.677E-10	3.088E-05
Cobalt	1.028E-03	NM (c)	3.751E-07	2.297E-06	1.042E-03	1.001E-10	8.401E-06
Copper	4.130E-02	NM (c)	1.507E-05	9.230E-05	4.187E-02	4.021E-09	3.376E-04
Lead	3.188E-02	NM (c)	1.164E-05	7.125E-05	3.232E-02	3.104E-09	2.606E-04
Magnesium	7.880E+01	NM (c)	2.877E-02	1.761E-01	7.989E+01	7.674E-06	6.443E-01
Manganese	2.958E-02	NM (c)	6.611E-05	2.999E-02	2.880E-09	2.418E-04	2.418E-04
Nickel	5.043E-03	NM (c)	1.841E-06	1.127E-05	5.113E-03	4.911E-10	4.123E-05
Phosphorus	3.234E-02	NM (c)	1.181E-05	7.229E-05	3.279E-02	3.150E-09	2.644E-04
Selenium	ND	NM (c)	ND	ND	ND	ND	ND
Silver	ND	NM (c)	ND	ND	ND	ND	ND
Thallium	ND	NM (c)	ND	ND	ND	ND	ND
Zinc	6.297E-01	NM (c)	2.298E-04	1.407E-03	6.384E-01	6.131E-08	5.148E-03
Mercury	9.773E-06	NM (c)	3.567E-09	2.184E-08	9.908E-06	9.516E-13	7.990E-08

**Table B-2: Air Modeling Output Data for Volatile Organic Compounds**

		155mm Illumination Round		Items per event (i)		1 items/hour	
		Average NEW, lb = 6.12		release duration (t):		124 seconds	
		Average Number of Items = 1		Unit Concentration (UC):		1.191E-05 g/m <sup>3</sup> /g(s)	
Compound	Measured Actual Concentration (mg/m <sup>3</sup> )	Measured Background Concentration (mg/m <sup>3</sup> )	Average Adjusted Emission Factor (lb/ft <sup>2</sup> NEW)	Average Adjusted Emission Factor (lb/ft <sup>2</sup> NEW)	Total Mass of Pollutant Emitted (grams/item)	Pollutant Concentration 3 Items (grams/m <sup>3</sup> ) CONC	* Event Pollutant Emission Rate 3 Items (g/sec) ER <sub>3</sub>
Total Nonmethane Hydrocarbons (TNMHC)	7.089E-01	3.620E-02	2.489E-04	1.524E-03	6.912E-01	6.639E-08	5.574E-03
Volatile Organic Compounds (VOCs)							
1,1,2,2-tetrachloroethane	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	8.568E-04	8.563E-04	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	9.123E-04	4.522E-04	1.702E-07	1.042E-06	4.727E-04	4.541E-11	3.812E-06
1,2,4-Trimethylbenzene & sec-Butylbenzene	3.650E-03	4.000E-04	1.202E-06	7.362E-06	3.339E-03	3.207E-10	2.693E-05
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	1.050E-03	2.000E-04	3.145E-07	1.925E-06	8.734E-04	8.389E-11	7.043E-06
1,3,5-Trimethylbenzene	2.760E-04	ND	1.021E-07	6.252E-07	2.836E-04	2.724E-11	2.287E-06
1,3-Butadiene	ND	ND	ND	ND	ND	ND	ND
1,3-Butadiene	ND	ND	ND	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND	ND	ND	ND
1-Butanol	ND	ND	ND	ND	ND	ND	ND
1-Butene	8.750E-03	ND	3.237E-06	1.982E-05	8.991E-03	8.635E-10	7.250E-05
1-Hexene	4.950E-03	ND	1.831E-06	1.121E-05	5.086E-03	4.885E-10	4.102E-05
1-Hydroxy-2-propanone	ND	ND	ND	ND	ND	ND	ND
1-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND
1-Pentene	3.500E-03	ND	1.285E-06	7.928E-06	3.596E-03	3.454E-10	2.900E-05
1-Propanol	ND	ND	ND	ND	ND	ND	ND
2,2,4-Trimethylhexane	1.000E-03	2.000E-04	2.980E-07	1.812E-06	8.220E-04	7.895E-11	6.629E-06
2,2,4-Trimethylpentane	5.500E-03	3.700E-03	6.659E-07	4.077E-06	1.849E-03	1.776E-10	1.492E-05
2,2-Dimethylbutane	ND	1.000E-04	ND	ND	ND	ND	ND
2,2-Dimethylheptane	ND	ND	ND	ND	ND	ND	ND
2,2-Dimethylpropane	ND	ND	ND	ND	ND	ND	ND
2,3,4-Trimethylpentane	1.050E-03	9.000E-04	5.549E-08	3.390E-07	1.541E-04	1.480E-11	1.243E-06
2,3-Butanedione	ND	ND	ND	ND	ND	ND	ND
2,3-Dihydro-1-methyl-1H-indene	ND	ND	ND	ND	ND	ND	ND
2,3-Dihydro-4-methyl-1H-indene	ND	ND	ND	ND	ND	ND	ND
2,3-Dimethylbutane	4.000E-04	4.000E-04	ND	ND	ND	ND	ND
2,3-Dimethylhexane	2.000E-04	4.000E-04	ND	ND	ND	ND	ND
2,3-Dimethylpentane	2.100E-03	1.900E-03	7.399E-08	4.530E-07	2.055E-04	1.974E-11	1.657E-06
2,4-4-Trimethyl-1-pentene	ND	ND	ND	ND	ND	ND	ND
2,4-4-Trimethyl-2-pentene	ND	ND	ND	ND	ND	ND	ND

**Table B-2: Air Modeling Output Data for Volatile Organic Compounds**

Compound	Measured Actual Concentration (mg/m <sup>3</sup> )	Measured Background Concentration (mg/m <sup>3</sup> )	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Factor (lb/lb NEW)	Total Mass of Pollutant Emitted (grams/item)	Pollutant Concentration 3 Items (grams/m <sup>3</sup> )	Pollutant Emission Rate 3 Items (g/sec/item)	•Event Pollutant Emission Rate 3 Items (g/sec)
					M	CONC	ER <sub>1</sub>	ER <sub>Rev</sub>
2,4-Dimethylhexane	7.500E-04	4.000E-04	1.295E-07	7.928E-07	3.596E-04	3.454E-11	2.900E-06	2.900E-06
2,4-Dimethylpentane	1.150E-03	9.000E-04	9.249E-08	5.663E-07	2.569E-04	2.467E-11	2.072E-06	2.072E-06
2,5-Dimethylhexane	4.500E-04	3.000E-04	5.549E-08	3.398E-07	1.541E-04	1.480E-11	1.243E-06	1.243E-06
2-Butanone	7.749E-03	7.941E-04	2.573E-06	1.576E-05	7.146E-03	6.864E-10	5.763E-05	5.763E-05
2-Butoxyethanol	ND	ND	ND	ND	ND	ND	ND	ND
2-Ethyl-1-hexanol	ND	ND	ND	ND	ND	ND	ND	ND
2-Furaldehyde	1.348E-02	ND	4.987E-06	3.053E-05	1.385E-02	1.330E-09	1.117E-04	1.117E-04
2-Methyl-1,3-dioxolane	ND	ND	ND	ND	ND	ND	ND	ND
2-Methyl-1-butene	1.400E-03	ND	5.179E-07	3.171E-06	1.438E-03	1.382E-10	1.160E-05	1.160E-05
2-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND
2-Methyl-2-butene	ND	ND	ND	ND	ND	ND	ND	ND
2-Methyl-2-pentene	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylfuran	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylheptane	3.000E-04	1.000E-04	7.399E-08	4.530E-07	2.055E-04	1.974E-11	1.657E-06	1.657E-06
2-Methylhexane	6.000E-04	4.000E-04	7.399E-08	4.530E-07	2.055E-04	1.974E-11	1.657E-06	1.657E-06
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylpentane	1.300E-03	8.000E-04	1.850E-07	1.133E-06	5.137E-04	4.934E-11	4.143E-06	4.143E-06
2-Methylpropanal	2.207E-03	ND	8.165E-07	4.999E-06	2.268E-03	2.178E-10	1.829E-05	1.829E-05
2-Methylpropanenitrile	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	8.901E-04	ND	3.293E-07	2.016E-06	9.145E-04	8.784E-11	7.375E-06	7.375E-06
2-Pentanone	1.577E-03	ND	5.836E-07	3.573E-06	1.621E-03	1.557E-10	1.307E-05	1.307E-05
2-Propanol	ND	ND	ND	ND	ND	ND	ND	ND
3-Ethylhexane	ND	ND	ND	ND	ND	ND	ND	ND
3-Methyl-1-butene	4.000E-04	ND	1.480E-07	9.061E-07	4.110E-04	3.948E-11	3.314E-06	3.314E-06
3-Methylhexane	9.000E-04	4.000E-04	1.850E-07	1.133E-06	5.137E-04	4.934E-11	4.143E-06	4.143E-06
3-Methylpentane	1.200E-03	7.000E-04	1.850E-07	1.133E-06	5.137E-04	4.934E-11	4.143E-06	4.143E-06
4-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND
6-Methyl-5-hepten-2-one	ND	4.461E-04	ND	ND	ND	ND	ND	ND
Acetic Acid	5.240E-03	1.105E-03	1.530E-06	9.366E-06	4.248E-03	4.081E-10	3.426E-05	3.426E-05
Acetone	6.430E-02	7.235E-03	2.111E-05	1.293E-04	5.863E-02	5.632E-09	4.729E-04	4.729E-04
Acetonitrile	1.137E-02	ND	4.208E-06	2.577E-05	1.169E-02	1.122E-09	9.425E-05	9.425E-05
Acetophenone	ND	6.648E-07	4.071E-06	1.846E-03	1.846E-03	1.773E-10	1.489E-05	1.489E-05
Acetylene	1.140E-01	7.000E-04	4.192E-05	2.567E-04	1.164E-01	1.118E-08	9.388E-04	9.388E-04
Acrolein	1.283E-02	ND	4.746E-06	2.906E-05	1.318E-02	1.266E-09	1.063E-04	1.063E-04
Acrylonitrile	9.319E-03	ND	3.448E-06	2.111E-05	9.575E-03	9.197E-10	7.722E-05	7.722E-05
Allylchloride	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Pinene	ND	ND	ND	ND	ND	ND	ND	ND
Benzaldehyde	8.789E-03	6.469E-04	3.012E-06	1.844E-05	8.366E-03	8.036E-10	6.747E-05	6.747E-05
Benzene	4.770E-02	1.100E-03	1.724E-05	1.056E-04	4.788E-02	4.599E-09	3.861E-04	3.861E-04
Benzene	4.852E-02	1.119E-03	1.754E-05	1.074E-04	4.870E-02	4.678E-09	3.927E-04	3.927E-04
Benzofuran	ND	ND	ND	ND	ND	ND	ND	ND
Benzonitrile	6.814E-03	ND	2.521E-06	1.544E-05	7.002E-03	6.725E-10	5.646E-05	5.646E-05
Benzylchloride	ND	ND	ND	ND	ND	ND	ND	ND
beta-Pinene	ND	ND	ND	ND	ND	ND	ND	ND
Butanal	1.550E-03	ND	5.660E-07	3.465E-06	1.572E-03	1.510E-10	1.268E-05	1.268E-05
Carbon Disulfide	2.962E-02	1.418E-03	1.043E-05	6.388E-05	2.891E-02	2.783E-09	2.337E-04	2.337E-04

**Table B-2: Air Modeling Output Data for Volatile Organic Compounds**

Compound	Measured Actual Concentration (mg/m <sup>3</sup> )	Measured Background Concentration (mg/m <sup>3</sup> )	Average Adjusted Emission Factor (lb/m NEW)	Average Adjusted Emission Factor (lb/m NEW)	Total Mass of Pollutant Emitted (grams/ft <sup>3</sup> )	Pollutant Concentration 3 Items (grams/m <sup>3</sup> ) CONC M	• Event Pollutant Emission Rate 3 Items (g/sec) ER, ERev		
							Pollutant Emission Rate (g/sec)Item ER	Pollutant Emission Rate (g/sec)Item ER, ERev	Pollutant Emission Rate (g/sec)Item ER, ERev
Carbon Tetrachloride	8.473E-04	7.746E-04	2.692E-08	1.648E-07	7.477E-05	7.181E-12	6.029E-07	6.029E-07	6.029E-07
Carbonyl Sulfide	1.697E-03	1.588E-04	5.690E-07	3.484E-06	1.580E-03	1.518E-10	1.274E-05	1.274E-05	1.274E-05
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloro-1-Propene	1.550E-03	ND	5.734E-07	3.511E-06	1.593E-03	1.530E-10	1.284E-05	1.284E-05	1.284E-05
cis-2-Butene	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-2-Pentene	4.000E-04	ND	1.480E-07	9.061E-07	4.110E-04	3.948E-11	3.314E-06	3.314E-06	3.314E-06
cis-4-Methyl-2-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND
CyanoGen	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cyclohexane	7.000E-04	2.0000E-04	1.850E-07	1.133E-06	5.137E-04	4.934E-11	4.143E-06	4.143E-06	4.143E-06
Cyclohexanone	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cyclopentane	5.000E-04	1.0000E-04	1.480E-07	9.061E-07	4.110E-04	3.948E-11	3.314E-06	3.314E-06	3.314E-06
Cyclopentanone	7.454E-02	ND	2.758E-05	1.688E-04	7.659E-02	7.356E-09	6.176E-04	6.176E-04	6.176E-04
Cyclopentene	1.800E-03	ND	6.659E-07	4.077E-06	1.849E-03	1.776E-10	1.492E-05	1.492E-05	1.492E-05
Decanal	3.168E-03	2.172E-03	3.686E-07	2.257E-06	1.024E-03	9.833E-11	8.256E-06	8.256E-06	8.256E-06
delta-3-Carene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	1.579E-03	1.507E-03	2.638E-08	1.615E-07	7.327E-05	7.037E-12	5.909E-07	5.909E-07	5.909E-07
Dichlorotetrafluoroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethyldisulfide	ND	ND	ND	ND	ND	ND	ND	ND	ND
d-Limonene	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethane	5.550E-03	2.500E-03	1.128E-06	6.909E-06	3.134E-03	3.010E-10	2.527E-05	2.527E-05	2.527E-05
Ethylbenzene	2.100E-03	3.000E-04	6.659E-07	4.077E-06	1.849E-03	1.776E-10	1.492E-05	1.492E-05	1.492E-05
Ethylbenzene	3.224E-03	4.606E-04	1.022E-06	6.260E-06	2.839E-03	2.727E-10	2.290E-05	2.290E-05	2.290E-05
Ethychloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
EthyCyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylene	1.243E-01	2.000E-04	4.591E-05	2.811E-04	1.275E-01	1.225E-08	1.028E-03	1.028E-03	1.028E-03
Furan	2.073E-03	ND	7.671E-07	4.697E-06	2.130E-03	2.046E-10	1.718E-05	1.718E-05	1.718E-05
Hepanal	1.567E-03	9.731E-04	2.197E-07	1.345E-06	6.102E-04	5.861E-11	4.921E-06	4.921E-06	4.921E-06
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexanal	1.607E-03	1.206E-03	1.483E-07	9.080E-07	4.119E-04	3.956E-11	3.321E-06	3.321E-06	3.321E-06
Hexanenitrile	2.798E-03	ND	1.035E-06	6.338E-06	2.875E-03	2.761E-10	2.318E-05	2.318E-05	2.318E-05
i-Butane	7.500E-04	1.0000E-04	2.405E-07	1.472E-06	6.679E-04	6.415E-11	5.386E-06	5.386E-06	5.386E-06
i-Butene	1.070E-02	ND	3.959E-06	2.424E-05	1.059E-02	1.056E-09	8.866E-05	8.866E-05	8.866E-05
Indane	ND	ND	ND	ND	ND	ND	ND	ND	ND
i-Pentane	1.0000E-03	5.0000E-04	1.850E-07	1.133E-06	5.133E-04	4.934E-11	4.143E-06	4.143E-06	4.143E-06
i-Propylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isoprene	ND	2.0000E-04	ND	ND	ND	ND	ND	ND	ND
m&p-Xylene	3.197E-03	1.321E-03	6.942E-07	4.280E-06	1.928E-03	1.852E-10	1.555E-05	1.555E-05	1.555E-05
m-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methacrolein	2.238E-03	ND	8.281E-07	5.070E-06	2.300E-03	2.209E-10	1.855E-05	1.855E-05	1.855E-05
Methyl Methacrylate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylbromide	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylchloride	ND	ND	ND	ND	ND	ND	ND	ND	ND

**Table B-2: Air Modeling Output Data for Volatile Organic Compounds**

Compound	Measured Actual Concentration (mg/m <sup>3</sup> )	Measured Background Concentration (mg/m <sup>3</sup> )	Average Emission Factor (lb/ton NEW)	Average Adjusted Emission Factor (lb/ton NEW)	Total Mass of Pollutant Emitted (grams/item)	Pollutant Concentration 3 Items (grams/m <sup>3</sup> )	Pollutant Emission Rate 3 Items (g/sec/item)	*Event Pollutant Emission Rate 3 Items (g/sec)
					M	CONC	ER <sub>3</sub>	ER <sub>EV</sub>
Methylchloroform	3.655E-04	3.777E-04	ND	ND	ND	ND	ND	ND
Methylcyclohexane	1.100E-03	2.000E-04	3.330E-07	2.039E-06	9.247E-04	8.882E-11	7.458E-06	7.458E-06
Methylcyclopentane	7.000E-04	4.000E-04	1.110E-07	6.796E-07	3.082E-04	2.961E-11	2.486E-06	2.486E-06
Methylenechloride	7.081E-03	2.044E-03	2.612E-04	1.599E-03	7.254E-01	6.968E-08	5.950E-03	5.950E-03
Methylnitrite	4.934E-03	ND	1.825E-06	1.118E-05	5.070E-03	4.870E-10	4.089E-05	4.089E-05
m-Ethyltoluene	8.000E-04	2.000E-04	2.220E-07	1.359E-06	6.165E-04	5.921E-11	4.972E-06	4.972E-06
Methyl-vinyl Ketone	1.426E-03	ND	5.275E-07	3.230E-06	1.465E-03	1.407E-10	1.182E-05	1.182E-05
MTBE	7.000E-04	7.000E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
m-Xylene & p-Xylene	6.468E-04	5.544E-04	3.419E-08	2.093E-07	9.496E-05	9.121E-12	7.658E-07	7.658E-07
Naphthalene	3.300E-03	1.400E-03	7.029E-07	4.304E-06	1.952E-03	1.875E-10	1.574E-05	1.574E-05
n-Butane	9.705E-03	3.067E-04	3.477E-06	2.129E-05	9.657E-03	9.275E-10	7.788E-05	7.788E-05
n-Decane	3.600E-03	4.000E-04	1.184E-06	7.249E-06	3.288E-03	3.158E-10	2.652E-05	2.652E-05
n-Hexane	1.100E-03	3.000E-04	2.960E-07	1.812E-06	8.220E-04	7.895E-11	6.629E-06	6.629E-06
Nitromethane	1.950E-03	8.000E-04	4.254E-07	2.605E-06	1.182E-03	1.135E-10	9.529E-06	9.529E-06
n-Nonane	5.091E-03	ND	1.884E-06	1.153E-05	5.231E-03	5.024E-10	4.219E-05	4.219E-05
n-Octane	6.000E-04	ND	2.220E-07	1.359E-06	6.165E-04	5.921E-11	4.972E-06	4.972E-06
Nonane	6.000E-04	1.000E-04	1.850E-07	1.133E-06	5.137E-04	4.934E-11	4.143E-06	4.143E-06
n-Pentane	1.700E-03	6.000E-04	4.070E-07	2.492E-06	7.092E-04	6.811E-11	5.719E-06	5.719E-06
n-Propylbenzene	7.500E-04	2.000E-04	2.035E-07	1.246E-06	5.651E-04	5.428E-11	4.557E-06	4.557E-06
Octanal	1.990E-03	1.464E-03	1.948E-07	1.193E-06	5.410E-04	5.197E-11	4.363E-06	4.363E-06
o-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
o-Ethyltoluene	7.000E-04	1.000E-04	2.220E-07	1.359E-06	6.165E-04	5.921E-11	4.972E-06	4.972E-06
o-Xylene	2.450E-03	5.000E-04	7.214E-07	4.417E-06	2.004E-03	1.924E-10	1.616E-05	1.616E-05
o-Xylene	2.492E-03	5.086E-04	7.338E-07	4.493E-06	2.038E-03	1.957E-10	1.643E-05	1.643E-05
p-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Pentanal	4.933E-03	1.610E-03	1.229E-06	7.522E-06	3.414E-03	3.279E-10	2.753E-05	2.753E-05
Pentanenitrile	2.369E-03	ND	8.764E-07	5.386E-06	2.434E-03	2.338E-10	1.963E-05	1.963E-05
Perchloroethylene	ND	ND	ND	ND	ND	ND	ND	ND
p-Ethyltoluene	3.400E-03	3.000E-04	1.147E-06	7.022E-06	3.185E-03	3.059E-10	2.569E-05	2.569E-05
p-Ethyltoluene	4.868E-04	ND	1.808E-07	1.107E-06	5.022E-04	4.824E-11	4.050E-06	4.050E-06
Phenylacetylene	2.300E-03	ND	8.507E-07	5.209E-06	2.363E-03	2.269E-10	1.905E-05	1.905E-05
Propane	1.745E-02	8.000E-04	6.160E-06	3.772E-05	1.711E-02	1.643E-09	1.380E-04	1.380E-04
Propanenitrile	2.143E-03	ND	7.928E-07	4.855E-06	2.202E-03	2.115E-10	1.776E-05	1.776E-05
Propene	1.885E-02	ND	6.974E-06	4.270E-05	1.937E-02	1.860E-09	1.562E-04	1.562E-04
Styrene	ND	ND	ND	ND	ND	ND	ND	ND
Styrene	2.440E-04	ND	9.028E-08	5.528E-07	2.507E-04	2.408E-11	2.022E-06	2.022E-06
Tetrahydrofuran	1.321E-03	ND	4.886E-07	2.981E-06	1.357E-03	1.303E-10	1.094E-05	1.094E-05
Thiophene	1.360E-02	3.000E-03	3.922E-06	2.401E-05	1.089E-02	1.046E-09	8.783E-05	8.783E-05
Toluene	1.383E-02	3.051E-03	3.969E-06	2.442E-05	1.108E-02	1.064E-09	8.934E-05	8.934E-05
trans-1,3-Dichloro-1-propene	ND	ND	ND	ND	ND	ND	ND	ND
trans-2-Butenal	1.474E-03	ND	5.454E-07	3.340E-06	1.515E-03	1.455E-10	1.222E-05	1.222E-05
trans-2-Butene	3.700E-03	ND	1.369E-06	8.361E-06	3.802E-03	3.651E-10	3.066E-05	3.066E-05
trans-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND

**Table B-2: Air Modeling Output Data for Volatile Organic Compounds**

Compound	Measured Actual Concentration (mg/m <sup>3</sup> )	Background Concentration (mg/m <sup>3</sup> )	Average Adjusted Emission Factor (lb/ft NEW)	Average Adjusted Emission Factor (lb/ft item)	Total Mass of Pollutant Emitted (grams/item)	Pollutant Concentration 3 Items (grams/m <sup>3</sup> ) CONC	Pollutant Emission Rate (g/sec)/item ER <sub>1</sub>	Pollutant Emission Rate 3 Items (g/sec) ER <sub>av</sub>
trans-2-Pentene	5.500E-04	ND	2.035E-07	1.246E-06	5.651E-04	5.429E-11	4.557E-06	4.557E-06
Trichloroethylene	ND	ND	ND	ND	ND	ND	ND	ND
Trichloromonofluoromethane	2.526E-03	2.516E-03	4.275E-09	2.618E-08	1.187E-05	1.140E-12	9.576E-08	9.576E-08
Vinylidenechloride	ND	ND	ND	ND	ND	ND	ND	ND

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

Compound	155mm illumination Round		Items per event (l)		1 items/hour	
	Average NEW, lb = 6.12		release duration (t):		124 seconds	
	Average Number of Items = 1		Unit Concentration (UC):		1.191E-05 g/m <sup>3</sup> /g(s)	
Measured Actual Concentration (mg/m <sup>3</sup> )	Measured Background Concentration (mg/m <sup>3</sup> )	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item)	Pollutant Concentration 3 items (grams/m <sup>3</sup> ) CONC	Pollutant Emission Rate (g/sec)/Item ER <sub>i</sub>
<b>Particulate/Vapor-phase SVOCs</b>						
1,2,4,5-Tetrachlorobenzene	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND
1,4-Naphthoquinone	ND	ND	ND	ND	ND	ND
1-Naphthylamine	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND
2-Acetylaminofluorene	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND
2-Naphthylamine	ND	ND	ND	ND	ND	ND
2-Nitroaniline	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND
2-Picoline	ND	ND	ND	ND	ND	ND
3,3-Dichlorobenzidine	ND	ND	ND	ND	ND	ND
3,3'-Dimethylbenzidine	ND	ND	ND	ND	ND	ND
3-Methylcholanthrene	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	ND
4-Bromophenylphenyl ether	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND
4-Chlorophenylphenyl ether	ND	ND	ND	ND	ND	ND
4-Methylphenol/3-Methylphenol	ND	ND	ND	ND	ND	ND
4-Nitroaniline	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND
4-Nitroquinoline-1-oxide	ND	ND	ND	ND	ND	ND
5-Nitro- <i>o</i> -toluidine	ND	ND	ND	ND	ND	ND

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m <sup>3</sup> )	Measured Background Concentration (mg/m <sup>3</sup> )	Average Adjusted Emission Factor (lb/s NEW)	Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item)	Concentration 3 Items (grams/m <sup>3</sup> ) CONC	Pollutant Emission Rate (g/sec) Item ER <sub>1</sub>	Pollutant Emission Rate (g/sec) Item ER <sub>2</sub>	Event Pollutant Emission Rate 3 Items (g/sec) ER <sub>3</sub>
7,12-Dimethylbenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetophenone	2.883E-03	2.071E-04	9.361E-07	6.038E-06	2.739E-03	2.630E-10	2.209E-05	2.209E-05	2.209E-05
Aniline	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benz(f)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benz(g,h)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benz(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzoic acid	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butylbenzylphthalate	3.028E-03	ND	1.116E-06	6.833E-06	3.100E-03	2.977E-10	2.500E-05	2.500E-05	2.500E-05
Carbazole	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diallate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,1)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	1.776E-03	1.381E-04	6.038E-07	3.697E-06	1.677E-03	1.611E-10	1.332E-05	1.332E-05	1.332E-05
Dimethylphenethylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	4.077E-03	7.691E-04	1.219E-06	7.465E-06	3.386E-03	3.252E-10	2.731E-05	2.731E-05	2.731E-05
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenylamine/N-NitrosodPDA	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isosafrole	ND	ND	ND	ND	ND	ND	ND	ND	ND
Kepone	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methaprylene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	5.579E-03	ND	2.056E-06	1.259E-05	5.710E-03	5.485E-10	4.605E-05	4.605E-05	4.605E-05

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m <sup>3</sup> )	Measured Background Concentration (mg/m <sup>3</sup> )	Average Adjusted Emission Factor (lb/d NEW)	Average Adjusted Emission Factor (lb/d NEW)	Total Mass of Pollutant Emitted (grams/item)	Pollutant Concentration 3 Items (grams/m <sup>3</sup> ) CONC	Pollutant Emission Rate (g/sec/item) ER <sub>i</sub>	* Event Pollutant Emission Rate 3 Items (g/sec) ER <sub>Ev</sub>
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiethylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosomethylisobutyramine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosomorpholine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopiperidine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopyrrolidine	ND	ND	ND	ND	ND	ND	ND	ND
o-Toluidine	ND	ND	ND	ND	ND	ND	ND	ND
p-Chloroaniline	ND	ND	ND	ND	ND	ND	ND	ND
p-Dimethylaminobiphenyl	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
Phenacetin	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND	ND
Pronamide	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND	ND
Pyridine	ND	ND	ND	ND	ND	ND	ND	ND
Safrole	ND	ND	ND	ND	ND	ND	ND	ND
sym-Trinitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND

## **APPENDIX C**

### **HEALTH-BASED SCREENING LEVELS AND ACUTE TOXICITY VALUES**

Appendix C: Health-based Screening Levels and Acute Toxicity Values

Compound	For the Chronic Evaluation (HBSL)						For the Acute Evaluation (ATV)			
	Region 9 PRG ( $\mu\text{g}/\text{m}^3$ )	Toxicity Endpoint (c or nc)	Region 3 RBC ( $\mu\text{g}/\text{m}^3$ )	Toxicity Endpoint (c or nc)	Health-based Screening Level ( $\mu\text{g}/\text{m}^3$ )	ERPG ( $\mu\text{g}/\text{m}^3$ )	TEEL ( $\mu\text{g}/\text{m}^3$ )	Source (T or E)	Acute Toxicity Value ( $\mu\text{g}/\text{m}^3$ )	
TSP	12789-66-1	5.00E+01	NA	NA	5.00E+01				0.00E+00	
PM <sub>10</sub>		5.00E+01	NA	NA	5.00E+01				0.00E+00	
HCl	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01			7.14E+03	
Cl <sub>2</sub>	7782-50-5	2.09E-01	nc	3.65E+02	nc	2.09E-01	2.89E+03	T	2.89E+03	
Dioxin TEQ	1746-01-6	4.48E-08	c	4.48E-08	c	4.48E-08			3.50E+00	
Carbon Monoxide (CO)	630-08-0	1.57E+02	NA	NA	1.57E+02	2.30E+05	2.28E+05	E	2.30E+05	
Nitrogen Oxide (NOX)	10024-97-2	1.00E+02	NA	NA	1.00E+02		2.70E+05	T	2.70E+05	
HCl (CEM System)	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01	7.14E+03	T	7.14E+03	
Carbon Dioxide (CO <sub>2</sub> )	124-38-9	NA	NA	NA	NA	5.40E+07	T		5.40E+07	
Sulfur Dioxide (SO <sub>2</sub> )	202-58-84	8.00E+01	NA	NA	8.00E+01	7.89E+02	7.86E+02	E	7.89E+02	
Aluminum	7429-90-5	NA	NA	3.65E+00	nc	3.65E+00	3.00E+04	T	3.00E+04	
Antimony	7440-36-0	NA	NA	1.46E+00	nc	1.46E+00	1.50E+03	T	1.50E+03	
Arsenic	7440-38-2	4.47E-04	c	4.15E-04	c	4.47E-04	3.00E+01	T	3.00E+01	
Barium	7440-39-3	5.21E-01	nc	5.11E-01	nc	5.21E-01	1.50E+03	T	1.50E+03	
Beryllium	7440-41-7	8.00E-04	c	7.45E-04	c	8.00E-04	5.00E+00	T	5.00E+00	
Cadmium	7440-43-9	1.07E-03	c	9.94E-04	c	1.07E-03	3.00E+01	T	3.00E+01	
Chromium	7440-43-9		c	1.53E-04	c	1.53E-04	1.50E+03	T	1.50E+03	
Cobalt	7440-48-4	NA		2.20E+02	nc	2.20E+02	6.00E+01	T	6.00E+01	
Copper	7440-50-8	NA		1.46E+02	nc	1.46E+02	3.00E+03	T	3.00E+03	
Lead	7439-92-1	1.50E+00		NA		1.50E+00	1.50E+02	T	1.50E+02	
Magnesium	7439-95-4	NA		NA		NA	3.00E+04	T	3.00E+04	
Manganese	7439-96-5	5.11E-02	nc	5.22E-02	nc	5.11E-02	3.00E+03	T	3.00E+03	
Nickel	7440-02-0	NA		7.30E+01	nc	7.30E+01	3.00E+03	T	3.00E+03	
Phosphorus	7723-14-0	NA		NA		NA	3.00E+02	T	3.00E+02	
Selenium	7782-49-2	NA		1.83E+01	nc	1.83E+01	6.00E+02	T	6.00E+02	
Silver	7740-22-4	NA		1.83E+01	nc	1.83E+01			0.00E+00	
Thallium	7440-28-0	NA		2.56E-01	nc	2.56E-01			0.00E+00	
Zinc	7440-66-6	NA		1.10E+03	nc	1.10E+03	3.00E+04	T	3.00E+04	
Mercury	7439-97-6	3.13E-01	nc	3.14E-01	nc	3.13E-01	1.00E+02	T	1.00E+02	
TNMHC		NA		NA		NA			0.00E+00	
1,1,2,2-Tetrachloroethane	79-34-5	3.31E-02	c	3.13E-02	c	3.31E-02			0.00E+00	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	3.13E+04	nc	3.14E+04	nc	3.13E+04	9.58E+06	T	9.58E+06	
1,1,2-Trichloroethane	79-00-5	1.20E-01	c	1.12E-01	c	1.20E-01			0.00E+00	
1,1-Dichloroethane	75-34-3	5.21E+02	nc	5.11E+02	nc	5.21E+02			0.00E+00	
1,2,4-Trichlorobenzene	120-82-1	2.1E+02	nc	2.08E+02	nc	2.08E+02	3.71E+04	T	3.71E+04	
1,2,4-Trimethylbenzene	95-63-6	6.21E+00	nc	6.21E+00	nc	6.21E+00	1.80E+05	T	1.80E+05	

**Appendix C: Health-based Screening Levels and Acute Toxicity Values**

Compound	CAS #	For the Chronic Evaluation (HBSL)						For the Acute Evaluation (ATV)			
		Region 9 PRG (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m <sup>3</sup> )	ERPG (µg/m <sup>3</sup> )	TEEL (µg/m <sup>3</sup> )	Source (T or E)	Acute Toxicity Value (µg/m <sup>3</sup> )	
1,2,4-Trimethylbenzene & sec-Butylbenzene	135-98-8	3.65E+01	nc	3.65E+01	nc	3.65E+01				0.00E+00	
1,2-Dibromoethane	106-93-4	8.73E-03	c	8.24E-03	c	8.73E-03				0.00E+00	
1,2-Dichloroethane	107-06-2	7.39E-02	c	6.88E-02	c	7.39E-02				0.00E+00	
1,2-Dichloroethene	540-59-0	NA		3.29E+01	nc	3.29E+01				2.38E+06	
1,2-Dichloropropane	78-87-5	9.89E-02	c	9.21E-02	c	9.89E-02				0.00E+00	
1,3,5-Trimethylbenzene	108-67-8	6.21E+00	nc	6.21E+00	nc	6.21E+00				3.68E+05	
1,3,5-Trimethylbenzene	108-67-8	6.21E+00	nc	6.21E+00	nc	6.21E+00				3.68E+05	
1,3-Butadiene	106-99-0	3.7E-03	c	3.48E-03	c	3.74E-03				2.20E+04	
1,3-Butadiene	106-99-0	3.7E-03	c	3.48E-03	c	3.74E-03				2.20E+04	
1,4-Dioxane	123-91-1	6.11E-01	c	9.13E+01	c	6.11E-01				0.00E+00	
1-Butanol	71-36-3	3.65E+02	nc	3.65E+02	nc	3.65E+02				0.00E+00	
1-Butene	106-98-9	NA		NA		NA				0.00E+00	
1-Hexene	592-41-6	NA		NA		NA				0.00E+00	
1-Hydroxy-2-propanone	116-09-6	NA		NA		NA				0.00E+00	
1-Methylnaphthalene	90-12-0	NA		NA		NA				0.00E+00	
1-Pentene	109-67-1	NA		NA		NA				0.00E+00	
1-Propanol	71-23-8	NA		NA		NA				0.00E+00	
2,2,4-Trimethylhexane	16747-25-5	NA		NA		NA				0.00E+00	
2,2,4-Trimethylpentane	540-84-1	NA		NA		NA				3.50E+05	
2,2-Dimethylbutane	75-83-2	NA		NA		NA				1.80E+06	
2,2-Dimethylheptane	1071-26-7	NA		NA		NA				0.00E+00	
2,2-Dimethylpropane	463-82-1	NA		NA		NA				0.00E+00	
2,3,4-Trimethylpentane	565-75-3	NA		NA		NA				0.00E+00	
2,3-Butanedione	431-03-8	NA		NA		NA				0.00E+00	
2,3-Dihydro-1-methyl-1H-indene	767-58-8	NA		NA		NA				0.00E+00	
2,3-Dihydro-4-methyl-1H-indene		NA		NA		NA				0.00E+00	
2,3-Dimethylbutane	79-29-8	NA		NA		NA				0.00E+00	
2,3-Dimethylhexane	584-94-1	NA		NA		NA				0.00E+00	
2,3-Dimethylpentane	565-59-3	NA		NA		NA				0.00E+00	
2,4,4-Trimethyl-1-pentene	107-39-1	NA		NA		NA				0.00E+00	
2,4,4-Trimethyl-2-pentene	107-40-4	NA		NA		NA				0.00E+00	
2,4-Dimethylhexane	589-43-5	NA		NA		NA				0.00E+00	
2,4-Dimethylpentane	108-08-7	NA		NA		NA				0.00E+00	
2,5-Dimethylhexane	592-13-2	NA		NA		NA				0.00E+00	
2-Butanone	78-93-3	1.04E+03	nc	1.04E+03	nc	1.04E+03				8.85E+05	
2-Butoxyethanol	111-76-2	2.09E+01	nc	2.08E+01	nc	2.09E+01				0.00E+00	
2-Ethyl-1-hexanol	104-76-7	NA		NA		NA				0.00E+00	

### Appendix C: Health-based Screening Levels and Acute Toxicity Values

Compound	CAS #	For the Chronic Evaluation (HBSI)					For the Acute Evaluation (ATV)			
		Region 9 PRG ( $\mu\text{g}/\text{m}^3$ )	Toxicity Endpoint (c or nc)	Region 3 RBC ( $\mu\text{g}/\text{m}^3$ )	Toxicity Endpoint (c or nc)	Health-based Screening Level ( $\mu\text{g}/\text{m}^3$ )	ERPG ( $\mu\text{g}/\text{m}^3$ )	TEEL ( $\mu\text{g}/\text{m}^3$ )	Source (T or E)	Acute Toxicity Value ( $\mu\text{g}/\text{m}^3$ )
2-Furaldehyde	98-01-1	5.21E+01	nc	3.65E+01	nc	5.21E+01	8.00E+03		E	8.00E+03
2-Methyl-1,3-dioxolane	497-26-7	NA	NA	NA	NA	NA				0.00E+00
2-Methyl-1-butene	563-46-2	NA	NA	NA	NA	NA				0.00E+00
2-Methyl-1-pentene	763-29-1	NA	NA	NA	NA	NA				0.00E+00
2-Methyl-2-butene	513-35-9	NA	NA	NA	NA	NA				0.00E+00
2-Methyl-2-pentene	625-27-4	NA	NA	NA	NA	NA				0.00E+00
2-Methylfuran	534-22-5	NA	NA	NA	NA	NA				0.00E+00
2-Methylheptane	592-27-8	NA	NA	NA	NA	NA				0.00E+00
2-Methylhexane	591-76-4	NA	NA	NA	NA	NA				0.00E+00
2-Methylnaphthalene	91-57-6	NA	NA	7.30E+01	nc	7.30E+01	2.00E+04	T		2.00E+04
2-Methylpentane	107-83-5	NA	NA	NA	NA	NA	1.80E+06	T		1.80E+06
2-Methylpropanal	78-84-2	NA	NA	NA	NA	NA				0.00E+00
2-Methylpropanenitrile	78-82-0	NA	NA	NA	NA	NA				0.00E+00
2-Nitrophenol	88-75-5	NA	NA	NA	NA	NA				0.00E+00
2-Pentanone	107-87-9	NA	NA	NA	NA	NA				0.00E+00
2-Propanol	67-63-0	NA	NA	NA	NA	NA				0.00E+00
3-Ethylhexane	619-99-8	NA	NA	NA	NA	NA				0.00E+00
3-Methyl-1-butene	563-45-1	NA	NA	NA	NA	NA				0.00E+00
3-Methylhexane	589-34-4	NA	NA	NA	NA	NA				0.00E+00
3-Methylpentane	96-14-0	NA	NA	NA	NA	NA				0.00E+00
4-Methyl-1-pentene	691-37-2	NA	NA	NA	NA	NA				0.00E+00
6-Methyl-5-hepten-2-one	101-99-0	NA	NA	NA	NA	NA				0.00E+00
Acetic Acid	64-19-7	NA	NA	NA	NA	NA	3.68E+04	T		3.68E+04
Acetone	67-64-1	3.65E+02	nc	3.65E+02	nc	3.65E+02	2.37E+06	T		2.37E+06
Acetonitrile	75-05-8	6.2E+01	nc	6.21E+01	nc	6.21E+01	1.01E+05	T		1.01E+05
Acetophenone	98-86-2	2.08E-02	nc	2.08E-02	nc	2.08E-02	3.00E+04	T		3.00E+04
Acetylene	74-86-2	NA	NA	NA	NA	NA				0.00E+00
Acrolein	107-02-8	2.09E-02	nc	2.08E-02	nc	2.09E-02	2.30E+02	2.29E+02	E	2.30E+02
Acrylonitrile	107-13-1	2.83E-02	c	2.61E-02	c	2.83E-02	2.20E+04		E	2.20E+04
Allylchloride	107-05-1	1.04E+00	nc	NA	NA	1.04E+00				0.00E+00
alpha-Pinene	80-56-8	NA	NA	NA	NA	NA				0.00E+00
Benzaldehyde	100-52-7	3.65E+02	nc	3.65E+02	nc	3.65E+02	1.50E+04	T		1.50E+04
Benzene	71-43-2	2.5E-01	c	2.16E-01	c	2.49E-01	1.56E+05	E		1.56E+05
Benzene	71-43-2	2.5E-01	c	2.16E-01	c	2.49E-01	1.56E+05	E		1.56E+05
Benzofuran	271-89-6	NA	NA	NA	NA	NA				0.00E+00
Benzonitrile	100-47-0	NA	NA	NA	NA	NA	1.50E+04	T		1.50E+04
Benzylchloride	100-44-7	3.96E-02	c	3.68E-02	c	3.96E-02				0.00E+00

**Appendix C: Health-based Screening Levels and Acute Toxicity Values**

Compound	CAS #	For the Chronic Evaluation (HBSL)						For the Acute Evaluation (ATV)		
		Region 9 PRG ( $\mu\text{g}/\text{m}^3$ )	Toxicity Endpoint (c or nc)	Region 3 RBC ( $\mu\text{g}/\text{m}^3$ )	Toxicity Endpoint (c or nc)	Health-based Screening Level ( $\mu\text{g}/\text{m}^3$ )	ERPG ( $\mu\text{g}/\text{m}^3$ )	TEEL ( $\mu\text{g}/\text{m}^3$ )	Source (T or E)	Acute Toxicity Value ( $\mu\text{g}/\text{m}^3$ )
beta-Pinene	127-91-3	NA	NA	NA	NA	NA				0.00E+00
Butanal	123-72-8	NA	NA	NA	NA	NA	7.38E+04	T		7.38E+04
Carbon Disulfide	75-15-0	7.30E+02	nc	7.30E+02	nc	7.30E+02	3.10E+03	3.73E+04	E	3.10E+03
Carbonetrachloride	56-23-5	1.28E-01	c	1.18E-01	c	1.28E-01	1.28E+05		E	1.28E+05
Carbonyl Sulfide	463-58-1	NA	NA	NA	NA	NA	9.84E+03	T		9.84E+03
Chlorobenzene	108-90-7	6.2E+01	nc	6.21E+01	nc	6.21E+01				0.00E+00
Chloroethene	75-01-4	2.24E-02	c	2.09E-02	c	2.24E-02				0.00E+00
Chloroform	67-66-3	8.35E-02	c	7.73E-02	c	8.35E-02	2.48E+05		E	2.48E+05
cis 1,3-Dichloro-1-propene	10061-01-5	5.17E-02	c	4.82E-02	c	5.17E-02				0.00E+00
cis-2-Butene	590-18-1	NA	NA	NA	NA	NA				0.00E+00
cis-2-Hexene	7688-21-3	NA	NA	NA	NA	NA				0.00E+00
cis-2-Pentene	627-20-3	NA	NA	NA	NA	NA				0.00E+00
cis-4-Methyl-2-pentene	691-38-3	NA	NA	NA	NA	NA				0.00E+00
Cyanogen	2074-87-5	NA	NA	NA	NA	NA				0.00E+00
Cyclohexane	110-82-7	NA	NA	NA	NA	NA				0.00E+00
Cyclohexanone	108-94-1	1.83E+04	nc	1.83E+04	nc	1.83E+04				0.00E+00
Cyclopentane	278-92-3	NA	NA	NA	NA	NA				0.00E+00
Cyclopentane	120-92-3	NA	NA	NA	NA	NA				0.00E+00
Cyclopentene	142-29-0	NA	NA	NA	NA	NA				0.00E+00
Decanal	112-31-2	NA	NA	NA	NA	NA				0.00E+00
delta-3-Carene	13466-78-9	NA	NA	NA	NA	NA				0.00E+00
Dichlorodifluoromethane	75-71-8	2.09E+02	nc	1.83E+02	nc	2.09E+02	1.48E+07	T		1.48E+07
Dichlorotetrafluoroethane	1320-37-2	NA	NA	NA	NA	NA				0.00E+00
Dimethyldisulfide	624-92-0	NA	NA	NA	NA	NA				0.00E+00
d-Limonene	5989-27-5	NA	NA	NA	NA	NA				0.00E+00
ETBE	637-92-3	NA	NA	NA	NA	NA				0.00E+00
Ethane	74-84-0	NA	NA	NA	NA	NA				0.00E+00
Ethylbenzene	100-41-4	1.06E+03	nc	1.06E+03	nc	1.06E+03				5.43E+05
Ethylbenzene	100-41-4	1.06E+03	nc	1.06E+03	nc	1.06E+03	5.43E+05	T		5.43E+05
Ethylchloride	75-00-3	2.3E+00	nc	NA	NA	2.32E+00				0.00E+00
Ethylcyclohexane	1678-91-7	NA	NA	NA	NA	NA				0.00E+00
Ethylene	74-85-1	NA	NA	NA	NA	NA	4.60E+05	T		4.60E+05
Furan	110-00-9	3.65E+00	nc	3.65E+00	nc	3.65E+00	1.67E+02	T		1.67E+02
Heptanal	111-71-7	NA	NA	NA	NA	NA				0.00E+00
Hexachlorobutadiene	87-68-3	8.73E-02	c	8.03E-02	c	8.73E-02				0.00E+00
Hexanal	66-25-1	NA	NA	NA	NA	NA				0.00E+00
Hexanenitrile	628-73-9	NA	NA	NA	NA	NA				0.00E+00

### Appendix C: Health-based Screening Levels and Acute Toxicity Values

Compound	CAS #	For the Chronic Evaluation (HBSEL)						For the Acute Evaluation (ATV)		
		Region 9 PRG (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m <sup>3</sup> )	ERPG (µg/m <sup>3</sup> )	TEEL (µg/m <sup>3</sup> )	Source (T or E)	Acute Toxicity Value (µg/m <sup>3</sup> )
i-Butane	75-28-5	NA	NA	NA	NA	NA	9.52E+05	—	9.52E+05	
i-Butene	115-11-7	NA	NA	NA	NA	NA	6.87E+06	—	6.87E+06	
Indane	496-11-7	NA	NA	NA	NA	NA	1.25E+05	—	1.25E+05	
i-Pentane	78-78-4	NA	NA	NA	NA	NA			0.00E+00	
i-Propylbenzene	98-82-8	4.02E+02	nc	4.02E+02	nc	4.02E+02			0.00E+00	
Isoprene	78-79-5	NA	NA	NA	NA	NA			0.00E+00	
m&p-Xylene	108-38-3	7.30E+02	nc	7.30E+03	nc	7.30E+02	6.51E+05	—	6.51E+05	
m-Dichlorobenzene	541-73-1	3.3E+00	nc	3.29E+00	nc	3.29E+00			0.00E+00	
Methacrolein	78-85-3	NA	NA	NA	NA	NA			0.00E+00	
Methyl Methacrylate	80-62-6	7.30E+02	nc	7.30E+02	nc	7.30E+02			0.00E+00	
Methyl bromide	74-83-9	5.21E+00	nc	5.11E+00	nc	5.21E+00			0.00E+00	
Methylchloride	74-87-3	1.07E+00	c	1.79E+00	c	1.07E+00			0.00E+00	
Methylchloroform	71-55-6	1.04E+03	nc	1.04E+03	nc	1.04E+03	1.94E+06	E	1.94E+06	
Methylcyclohexane	108-87-2	3.13E+03	nc	3.14E+03	nc	3.13E+03	4.81E+06	—	4.81E+06	
Methylcyclopentane	96-37-7	NA	NA	NA	NA	NA			0.00E+00	
Methylenechloride	75-09-2	4.09E+00	c	3.79E+00	c	4.09E+00	6.96E+05	E	6.96E+05	
Methyl nitrite	624-91-9	NA	NA	NA	NA	NA			0.00E+00	
m-Ethyltoluene	620-14-4	NA	NA	NA	NA	NA			0.00E+00	
Methyl-vinyl Ketone	78-94-4	NA	NA	NA	NA	NA	8.61E+01	—	8.61E+01	
MTBE	1634-04-4	3.13E+03	nc	3.13E+03	nc	3.13E+03	4.32E+05	—	4.32E+05	
MTBE	1634-04-4	3.13E+03	nc	3.13E+03	nc	3.13E+03	4.32E+05	—	4.32E+05	
m-Xylene & p-Xylene	108-38-3	7.30E+02	nc	7.30E+03	nc	7.30E+02	6.51E+05	—	6.51E+05	
Naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00	7.86E+04	—	7.86E+04	
n-Butane	106-97-8	NA	NA	NA	NA	NA			0.00E+00	
n-Decane	124-18-5	NA	NA	NA	NA	NA	4.37E+03		4.37E+03	
n-Heptane	142-82-5	NA	NA	NA	NA	NA	1.80E+06	—	1.80E+06	
n-Hexane	110-54-3	2.09E+02	nc	2.08E+02	nc	2.09E+02	5.28E+05	—	5.28E+05	
Nitromethane	75-52-5	NA	NA	NA	NA	NA	1.50E+05	—	1.50E+05	
n-Nonane	111-84-2	NA	NA	NA	NA	NA	1.05E+06	—	1.05E+06	
n-Octane	111-65-9	NA	NA	NA	NA	NA			0.00E+00	
Nonanal	124-19-6	NA	NA	NA	NA	NA			0.00E+00	
n-Pentane	109-66-0	NA	NA	NA	NA	NA	1.80E+06	—	1.80E+06	
n-Propylbenzene	103-65-1	3.65E+01	nc	NA	3.65E+01	—	3.68E+05	—	3.68E+05	
Octanal	124-13-0	NA	NA	NA	NA	NA			0.00E+00	
o-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02			0.00E+00	
o-Ethyltoluene	611-14-3	NA	NA	NA	NA	NA	7.50E+02	—	7.50E+02	

**Appendix C: Health-based Screening Levels and Acute Toxicity Values**

Compound	CAS #	For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
		Region 9 PRG (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m <sup>3</sup> )	ERPG (µg/m <sup>3</sup> )	TEEL (µg/m <sup>3</sup> )	Source (T or E)	Acute Toxicity Value (µg/m <sup>3</sup> )
o-Xylene	95-47-6	7.30E+02	nc	7.30E+03	nc	7.30E+02		6.51E+05	T	6.51E+05
o-Xylene	95-47-6	7.30E+02	nc	7.30E+03	nc	7.30E+02		6.51E+05	T	6.51E+05
p-Dichlorobenzene	106-46-7	2.80E-01	c	2.85E-01	c	2.80E-01				0.00E+00
Pentanal	110-62-3	NA		NA		NA				0.00E+00
Pentanenitrile	110-59-8	NA		NA		NA				0.00E+00
Perchloroethylene	127-18-4	3.31E+00	c	3.13E+00	c	3.31E+00		6.89E+05	6.78E+05	E
p-Ethyltoluene	622-96-8	NA		NA		NA		1.25E+05	T	1.25E+05
p-Ethyltoluene	622-96-8	NA		NA		NA		1.25E+05	T	1.25E+05
Phenylacetylene	536-74-3	NA		NA		NA				0.00E+00
Propane	74-98-6	NA		NA		NA		3.78E+06	T	3.78E+06
Propanenitrile	107-12-0	NA		NA		NA		3.38E+04	T	3.38E+04
Propene	115-07-1	NA		NA		NA				0.00E+00
Styrene	100-42-5	1.06E+03	nc	1.04E+03	nc	1.06E+03		2.13E+05	E	2.13E+05
Styrene	100-42-5	1.06E+03	nc	1.04E+03	nc	1.06E+03		2.13E+05	E	2.13E+05
Tetrahydrofuran	109-99-9	9.9E-01	nc	9.21E-01	c	9.89E-01				0.00E+00
Thiophene	110-02-1	NA		NA		NA				0.00E+00
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02		1.88E+05	E	1.88E+05
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02		1.88E+05	E	1.88E+05
trans-1,3-Dichloro-1-propene	10061-02-6	NA		NA		NA				0.00E+00
trans-2-Butenal	123-73-9	3.54E-03	c	3.30E-03	c	3.54E-03				0.00E+00
trans-2-Butene	624-64-6	NA		NA		NA				0.00E+00
trans-2-Hexene	4050-45-7	NA		NA		NA				0.00E+00
trans-2-Pentene	646-04-8	NA		NA		NA				0.00E+00
Trichloroethylene	79-01-6	1.12E+00	c	1.04E+00	c	1.12E+00				0.00E+00
Trichloromonofluoromethane	75-69-4	7.30E+02	nc	7.30E+02	nc	7.30E+02				0.00E+00
Vinyldenechloride	75-35-4	3.84E-02	c	3.58E-02	c	3.84E-02				0.00E+00
1,2,4,5-Tetrachlorobenzene	95-94-3	1.10E+00	nc	1.10E+00	nc	1.10E+00				0.00E+00
1,2,4-Trichlorobenzene	120-82-1	2.08E+02	nc	2.08E+02	nc	2.08E+02				0.00E+00
1,2-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02				0.00E+00
1,3-Dichlorobenzene	541-73-1	3.3E+00	nc	3.29E+00	nc	3.29E+00				0.00E+00
1,3-Dinitrobenzene	99-65-0	3.65E-01	nc	3.65E-01	nc	3.65E-01				0.00E+00
1,4-Dichlorobenzene	106-46-7	3.1E-01	c	2.85E-01	c	3.06E-01				0.00E+00
1,4-Naphthoquinone	130-15-4	NA		NA		NA				0.00E+00
1-Naphthylamine	134-32-7	NA		NA		NA				0.00E+00
2,3,4,6-Tetrachloropheno	58-90-2	1.10E+02	nc	1.10E+02	nc	1.10E+02				0.00E+00
2,4,5-Trichloropheno	95-95-4	3.65E+02	nc	3.65E+02	nc	3.65E+02				0.00E+00
2,4,6-Trichloropheno	88-06-2	6.20E-01	c	6.26E-01	c	6.20E-01				0.00E+00

**Appendix C: Health-based Screening Levels and Acute Toxicity Values**

Compound	CAS #	For the Chronic Evaluation (HBSL)				For the Acute Evaluation (ATV)				
		Region 9 PRG (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m <sup>3</sup> )	ERPG (µg/m <sup>3</sup> )	TEEL (µg/m <sup>3</sup> )	Source (T or E)	Acute Value (µg/m <sup>3</sup> )
2,4-Dichlorophenol	120-83-2	1.10E+01	nc	1.10E+01	nc	1.10E+01				0.00E+00
2,4-Dimethylphenol	105-67-9	7.30E+01	nc	7.30E+01	nc	7.30E+01				0.00E+00
2,4-Dinitrophenol	51-28-5	7.30E+00	nc	7.30E+00	nc	7.30E+00				0.00E+00
2,4-Dinitrotoluene	121-14-2	7.30E+00	nc	7.30E+00	nc	7.30E+00				0.00E+00
2,6-Dichlorophenol	87-65-0	NA		NA		NA				0.00E+00
2,6-Dinitrotoluene	606-20-2	3.7E+00	nc	3.65E+00	nc	3.65E+00				0.00E+00
2-Acetylaminofluorene	53-96-3	NA		NA		NA				0.00E+00
2-Chloronaphthalene	91-58-7	2.92E+02	nc	2.92E+02	nc	2.92E+02				0.00E+00
2-Chlorophenol	95-57-8	1.83E+01	nc	1.83E+01	nc	1.83E+01				0.00E+00
2-Methylnaphthalene	91-57-6	NA		7.30E+01	nc	7.30E+01				2.00E+04
2-Methylphenol	95-48-7	1.83E+02	nc	1.83E+02	nc	1.83E+02				0.00E+00
2-Naphthylamine	91-59-8	NA		NA		NA				0.00E+00
2-Nitroaniline	88-74-4	2.09E-01	nc	2.08E-01	nc	2.08E-01				0.00E+00
2-Nitrophenol	88-75-5	NA		NA		NA				0.00E+00
2-Picoline	109-06-8	NA		NA		NA				0.00E+00
3,3'-Dichlorobenzidine	91-94-1	1.49E-02	c	1.39E-02	c	1.49E-02				0.00E+00
3,3'-Dimethylbenzidine	119-93-7	7.31E-04	c	6.81E-04	c	7.31E-04				0.00E+00
3-Methylcholanthrene	56-49-5	NA		NA		NA				0.00E+00
3-Nitroaniline	99-09-2	NA		NA		NA				0.00E+00
4,6-Dinitro-2-methylphenol	534-52-1	NA		3.65E-01	nc	3.65E-01				0.00E+00
4-Aminobiphenyl	92-67-1	NA		NA		NA				0.00E+00
4-Bromophenylphenyl ether	101-55-3	NA		NA		NA				0.00E+00
4-Chloro-3-methylphenol	35421-08-8	NA		NA		NA				0.00E+00
4-Chlorophenylphenyl ether	7005-72-3	NA		NA		NA				0.00E+00
4-Methylphenol/3-Methylphenol	106-44-5	1.83E+01	nc	1.83E+01	nc	1.83E+01				0.00E+00
4-Nitroaniline	100-01-6	NA		NA		NA				0.00E+00
4-Nitrophenol	100-02-7	2.9E+01	nc	2.92E+01	nc	2.92E+01				0.00E+00
4-Nitroquinoline-1-oxide	56-57-5	NA		NA		NA				0.00E+00
5-Nitro-o-toluidine	99-52-5	NA		NA		NA				0.00E+00
7,12-Dimethylbenz(a)anthracene	57-97-6	NA		NA		NA				0.00E+00
Acenaphthene	83-32-9	2.19E+02	nc	2.19E+02	nc	2.19E+02				0.00E+00
Acenaphthylene	208-96-8	NA		NA		NA				2.00E+02
Acetophenone	98-86-2	2.08E-02	nc	2.08E-02	nc	2.08E-02				3.00E+04
Aniline	62-53-3	1.04E+00	nc	1.06E+00	nc	1.04E+00				2.29E+04
Anthracene	120-12-7	1.10E+03	nc	1.10E+03	nc	1.10E+03				0.00E+00
Benz(a)anthracene	56-55-3	2.17E-02	c	8.58E-03	c	2.17E-02				0.00E+00
Benz(a)pyrene	50-32-8	2.17E-03	c	2.02E-03	c	2.17E-03				0.00E+00

### Appendix C: Health-based Screening Levels and Acute Toxicity Values

Compound	CAS #	For the Chronic Evaluation (HBSL)						For the Acute Evaluation (ATV)		
		Region 9 PRG (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m <sup>3</sup> )	ERPG (µg/m <sup>3</sup> )	TEEL (µg/m <sup>3</sup> )	Source (T or E)	Acute Toxicity Value (µg/m <sup>3</sup> )
Benzidine	92-87-5	2.92E-05	c	2.72E-05	c	2.92E-05				0.00E+00
Benzo(b)fluoranthene	205-99-2	2.17E-02	c	8.58E-03	c	2.17E-02				0.00E+00
Benzo(g,h)perylene	191-24-2	NA		NA		NA				0.00E+00
Benzo(k)fluoranthene	207-08-9	2.17E-01	c	8.58E-02	c	2.17E-01				0.00E+00
Benzoic acid	65-85-0	1.46E+04	nc	1.46E+04	nc	1.46E+04				0.00E+00
Benzyl alcohol	100-51-6	1.10E+03	nc	1.10E+03	nc	1.10E+03	5.53E+04	T		5.53E+04
bis(2-Chloroethoxy)methane	111-91-1	NA		NA		NA				0.00E+00
bis(2-Chloroethyl)ether	111-44-4	5.82E-03	c	5.69E-03	c	5.82E-03				0.00E+00
bis(2-Chloroisopropyl)ether	108-60-1	1.92E-01	c	1.79E-01	c	1.92E-01				0.00E+00
bis(2-Ethylhexyl)phthalate	117-81-7	4.80E-01	c	4.47E-01	c	4.80E-01				0.00E+00
Butylbenzylphthalate	85-68-7	7.30E-02	nc	7.30E+02	nc	7.30E+02	5.00E+05	T		5.00E+05
Carbazole	86-74-8	3.36E-01	c	3.13E-01	c	3.36E-01				0.00E+00
Chlorobenzilate	510-15-6	2.49E-02	c	2.32E-02	c	2.49E-02				0.00E+00
Chrysene	218-01-9	2.17E+00	c	8.58E-01	c	2.17E+00				0.00E+00
Diallate	2303-16-4	1.10E-01	c	NA		1.10E-01				0.00E+00
Dibenz(a,h)anthracene	53-70-3	2.17E-03	c	8.58E-04	c	2.17E-03				0.00E+00
Dibenzofuran	132-64-9	1.46E+01	nc	1.46E+01	nc	1.46E+01				0.00E+00
Diethylphthalate	84-66-2	2.92E-03	nc	2.92E+03	nc	2.92E+03	1.50E+04	T		1.50E+04
Dimethylphthalate	122-09-8	3.65E+00	nc	NA		3.65E+00				0.00E+00
Dimethylphthalate	131-11-3	3.65E+04	nc	3.65E+04	nc	3.65E+04				0.00E+00
Di-n-butylphthalate	84-74-2	3.65E+02	nc	3.65E+02	nc	3.65E+02	1.50E+04	T		1.50E+04
Di-n-octylphthalate	117-84-0	7.30E+01	nc	7.30E+01	nc	7.30E+01	1.50E+05	T		1.50E+05
Diphenylamine/N-NitrosoDPA	122-39-4	9.13E+01	nc	9.13E+01	nc	9.13E+01				0.00E+00
Ethyl methanesulfonate	62-50-0	NA		NA		NA				0.00E+00
Fluoranthene	206-44-0	1.46E+02	nc	1.46E+02	nc	1.46E+02				0.00E+00
Fluorene	86-73-7	1.46E+02	nc	1.46E+02	nc	1.46E+02	7.50E+04	T		7.50E+04
Hexachlorobenzene	118-74-1	4.18E-03	c	3.91E-03	c	4.18E-03				0.00E+00
Hexachlorobutadiene	87-68-3	8.6E-02	c	8.03E-02	c	8.62E-02				0.00E+00
Hexachlorocyclopentadiene	77-47-4	7.30E-02	nc	7.30E-02	nc	7.30E-02				0.00E+00
Hexachloroethane	67-72-1	4.80E-01	c	4.47E-01	c	4.80E-01				0.00E+00
Hexachloropropene	1888-71-7	NA		NA		NA				0.00E+00
Indeno(1,2,3-cd)pyrene	193-39-5	2.17E-02	c	8.58E-03	c	2.17E-02				0.00E+00
Isophorone	78-59-1	7.08E+00	c	6.59E+00	c	7.08E+00				0.00E+00
Iosafrole	120-58-1	NA		NA		NA				0.00E+00
Kepone	143-50-0	3.74E-04	c	NA		3.74E-04				0.00E+00
Methapyrilene	91-80-5	NA		NA		NA				0.00E+00
Methyl methanesulfonate	66-27-3	NA		NA		NA				0.00E+00

### Appendix C: Health-based Screening Levels and Acute Toxicity Values

Compound	CAS #	For the Chronic Evaluation (HBSL)						For the Acute Evaluation (ATV)			
		Region 9 PRG (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m <sup>3</sup> )	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m <sup>3</sup> )	ERPG (µg/m <sup>3</sup> )	TEEL (µg/m <sup>3</sup> )	Source (T or E)	Acute Toxicity Value (µg/m <sup>3</sup> )	
Naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00		7.86E+04	T	7.86E+04	
Nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc	2.09E+00				0.00E+00	
N-Nitrosodimethylamine	55-18-5	4.47E-05	c	4.17E-05	c	4.47E-05				0.00E+00	
N-Nitrosodimethylamine	55-18-5	4.47E-05	c	4.17E-05	c	4.47E-05				0.00E+00	
N-Nitroso-di-n-butylamine	924-16-3	1.2E-03	c	1.12E-03	c	1.20E-03				0.00E+00	
N-Nitroso-di-n-propylamine	621-64-7	9.61E-04	c	8.94E-04	c	9.61E-04				0.00E+00	
N-Nitrosomethylalkylamine	10395-95-6	3.06E-04	c	2.85E-04	c	3.06E-04				0.00E+00	
N-Nitrosomorpholine	59-89-2	NA	NA	NA	NA	NA				0.00E+00	
N-Nitrosopiperidine	100-75-4	NA	NA	NA	NA	NA				0.00E+00	
N-Nitrosopyrrolidine	930-55-2	3.15E-03	c	NA	NA	3.15E-03				0.00E+00	
o-Tolidine	95-53-4	2.80E-02	c	NA	NA	2.80E-02				0.00E+00	
p-Chloroaniline	106-47-8	1.46E+01	nc	1.46E+01	nc	1.46E+01				0.00E+00	
p-Dimethylaminobenzene	60-11-7	NA	NA	NA	NA	NA				0.00E+00	
Pentachlorobenzene	608-93-5	2.92E+00	nc	2.92E+00	nc	2.92E+00				0.00E+00	
Pentachloroethane	76-01-7	NA	NA	NA	NA	NA				0.00E+00	
Pentachloronitrobenzene	82-68-8	2.59E-02	c	2.41E-02	c	2.59E-02				0.00E+00	
Pentachlorophenol	87-86-5	5.60E-02	c	5.22E-02	c	5.60E-02				0.00E+00	
Phenacetin	62-44-2	NA	NA	NA	NA	NA				0.00E+00	
Phenanthrene	85-01-8	NA	NA	NA	NA	NA				0.00E+00	
Phenol	108-95-2	2.19E+03	nc	2.19E+03	nc	2.19E+03				0.00E+00	
Promamide	23950-58-5	2.74E+02	nc	NA	NA	2.74E+02				0.00E+00	
Pyrene	129-00-1	NA	NA	NA	NA	NA				0.00E+00	
Pyridine	110-86-1	3.65E+00	nc	3.65E+00	nc	3.65E+00				0.00E+00	
Safrole	94-59-7	NA	NA	NA	NA	NA				0.00E+00	
sym-Trinitrobenzene	99-35-4	1.10E+02	nc	1.10E+02	nc	1.10E+02				0.00E+00	

Footnotes:

PRG: Preliminary Remediation Goals

c: Cancer

nc:non-cancer

RBC: Risk-Based Concentration

HBSL: Health-based Screening Level

(E) ERPG: Emergency Response Planning Guidelines

(I) TEEL: Temporary Emergency Exposure Limits

ATV: Acute Toxicity Value

NA: Not applicable

**APPENDIX D**

**RISK EVALUATION DATA**

Table D-1: Comparison of Air Concentrations With Health-Based Values: Metals, Particulates and Miscellaneous Compounds

Compound	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HBSL	155mm Illumination Round				
				> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )	C <sub>acute</sub> /ATV	> 1?
TSP	7.18E-02	5.00E+01	1.44E-03	no	NA	NV		na
PM <sub>10</sub>	1.02E-01	5.00E+01	2.05E-03	no	NA	NV		na
HCl (a)	NA	2.08E+01		na	NA	7.14E+03		na
Cl <sub>2</sub> (a)	NA	2.09E-01		na	NA	2.89E+03		na
Dioxin TEQ (b)	9.47E-14	4.48E-08	2.11E-06	no	1.55E-09	3.50E+00	4.43E-10	no
Carbon Monoxide (CO)	6.67E-04	1.57E+02	4.25E-06	no	1.17E+00	2.30E+05	5.08E-06	no
Nitrogen Oxide (NOx)	2.42E-03	1.00E+02	2.42E-05	no	1.69E+01	2.70E+05	6.27E-05	no
HCl (a)	4.71E-06	2.08E+01	2.26E-07	no	3.30E-02	7.14E+03	4.62E-06	no
Carbon Dioxide (CO <sub>2</sub> )	4.68E-02	NV		na	3.28E+02	5.40E+07	6.07E-06	no
Sulfur Dioxide (SO <sub>2</sub> )	7.10E-05	8.00E+01	8.88E-07	no	1.24E-01	7.89E+02	1.58E-04	no
Aluminum	1.21E-05	3.65E+00	3.32E-06	no	8.48E-02	3.00E+04	2.83E-06	no
Antimony	7.10E-07	1.46E+00	4.86E-07	no	4.98E-03	1.50E+03	3.32E-06	no
Arsenic	NA	4.47E-04		na	NA	3.00E+01		na
Barium	1.31E-05	5.21E-01	2.51E-05	no	9.18E-02	1.50E+03	6.12E-05	no
Beryllium	3.66E-15	8.00E-04	4.58E-12	no	5.99E-05	5.00E+00	1.20E-05	no
Cadmium	1.07E-06	1.07E-03	1.00E-03	no	1.75E-02	3.00E+01	5.82E-04	no
Chromium	9.99E-08	1.53E-04	6.55E-04	no	1.63E-03	1.50E+03	1.09E-06	no
Cobalt	6.35E-08	2.20E+02	2.88E-10	no	4.45E-04	6.00E+01	7.41E-06	no
Copper	2.55E-06	1.46E+02	1.75E-08	no	1.79E-02	3.00E+03	5.96E-06	no
Lead	1.97E-06	1.50E+00	1.31E-06	no	1.38E-02	1.50E+02	9.20E-05	no
Magnesium	4.87E-03	NV		na	3.41E+01	3.00E+04	1.14E-03	no
Manganese	1.83E-06	5.11E-02	3.57E-05	no	1.28E-02	3.00E+03	4.27E-06	no
Nickel	3.11E-07	7.30E+01	4.27E-09	no	2.18E-03	3.00E+03	7.28E-07	no
Phosphorus	2.00E-06	NV		na	1.40E-02	3.00E+02	4.67E-05	no
Selenium	NA	1.83E+01		na	NA	6.00E+02		na
Silver	NA	1.83E+01		na	NA	NV		na
Thallium	NA	2.56E-01		na	NA	NV		na
Zinc	3.89E-05	1.10E+03	3.55E-08	no	2.73E-01	3.00E+04	9.08E-06	no
Mercury	6.04E-16	3.13E-01	1.93E-15	no	4.23E-06	1.00E+02	4.23E-08	no

Footnote:

(a) HCl/Cl<sub>2</sub> levels were too low to be reliably measured.

(b) Presence questionable - reported at similar levels in samples and blanks.

NA = Not applicable because compound was not detected.

na = Not available because health-based screening value is not available or not applicable if compound was not detected.

NV = No value

C<sub>chronic</sub> = Chronic time-averaged concentration ; HBSL = Chronic health-based screening level

C<sub>acute</sub> = Acute concentration; ATV = Acute toxicity value

**Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds**

Compound (a)	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HBSL	155mm Illumination Round			C <sub>acute</sub> / ATV	> 1?
				> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )		
TNMHC	4.21E-05	NV		na	NA	NV	na	na
1,1,2,2-Tetrachloroethane	NA	3.31E-02		na	NA	NV	na	na
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	3.13E+04		na	NA	9.58E+06	na	na
1,1,2,2-Tetrachloroethane	NA	1.20E-01		na	NA	NV	na	na
1,1-Dichloroethane	NA	5.21E+02		na	NA	NV	na	na
1,2,4-Trichlorobenzene	NA	2.08E+02		na	NA	3.71E+04	na	na
<b>1,2,4-Trimethylbenzene</b>	<b>2.88E-08</b>	<b>6.21E+00</b>	<b>4.64E-09</b>	<b>no</b>	<b>2.02E-04</b>	<b>1.80E+05</b>	<b>1.12E-09</b>	<b>no</b>
1,2,4-Trimethylbenzene & sec-Butylbenzene	2.03E-07	3.65E+01	5.57E-09	no	NA	NV	na	na
1,2-Dibromoethane	NA	8.73E-03		na	NA	NV	na	na
1,2-Dichloroethane	NA	7.39E-02		na	NA	NV	na	na
1,2-Dichloroethene	NA	3.29E+01		na	NA	2.38E+06	na	na
1,2-Dichloropropane	NA	9.89E-02		na	NA	NV	na	na
1,3,5-Trimethylbenzene	5.32E-08	6.21E+00	8.57E-09	no	3.73E-04	3.68E+05	1.01E-09	no
<b>1,3,5-Trimethylbenzene</b>	<b>1.73E-08</b>	<b>6.21E+00</b>	<b>2.78E-09</b>	<b>no</b>	<b>1.21E-04</b>	<b>3.68E+05</b>	<b>3.29E-10</b>	<b>no</b>
1,3-Butadiene	NA	3.74E-03		na	NA	2.20E+04	na	na
<b>1,3-Butadiene</b>	<b>NA</b>	<b>3.74E-03</b>	<b>na</b>	<b>NA</b>	<b>NA</b>	<b>2.20E+04</b>	<b>na</b>	<b>na</b>
1,4-Dioxane	NA	6.11E-01		na	NA	NV	na	na
1-Butanol	NA	3.65E+02		na	NA	NV	na	na
1-Butene	5.48E-07	NV		na	NA	NV	na	na
1-Hexene	3.10E-07	NV		na	2.17E-03	1.03E+05	2.11E-08	no
1-Hydroxy-2-propanone	NA	NV		na	NA	NV	na	na
1-Methylnaphthalene	NA	NV		na	NA	NV	na	na
1-Pentene	2.19E-07	NV		na	NA	NV	na	na
1-Propanol	NA	NV		na	NA	NV	na	na
2,2,4-Trimethylhexane	5.01E-08	NV		na	NA	NV	na	na
2,2,4-Trimethylpentane	1.13E-07	NV		na	7.90E-04	3.50E+05	2.26E-09	no
2,2-Dimethylbutane	NA	NV		na	NA	1.80E+06	na	na
2,2-Dimethylheptane	NA	NV		na	NA	NV	na	na
2,2-Dimethylpropane	NA	NV		na	NA	NV	na	na
2,3,4-Trimethylpentane	9.39E-09	NV		na	NA	NV	na	na
2,3-Butanedione	NA	NV		na	NA	NV	na	na
2,3-Dihydro-1-methyl-1H-indene	NA	NV		na	NA	NV	na	na
2,3-Dihydro-4-methyl-1H-indene	NA	NV		na	NA	NV	na	na

**Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds**

Compound (a)	155mm Illumination Round							
	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HBSL	> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )	C <sub>acute</sub> / ATV	> 1?
2,3-Dimethylbutane	NA	NV		na	NA	NV	NV	na
2,3-Dimethylhexane	NA	NV		na	NA	NV	NV	na
2,3-Dimethylpentane	1.25E-08	NV		na	NA	NV	NV	na
2,4,4-Trimethyl-1-pentene	NA	NV		na	NA	NV	NV	na
2,4,4-Trimethyl-2-pentene	NA	NV		na	NA	NV	NV	na
2,4-Dimethylhexane	2.19E-08	NV		na	NA	NV	NV	na
2,4-Dimethylpentane	1.56E-08	NV		na	NA	NV	NV	na
2,5-Dimethylhexane	9.39E-09	NV		na	NA	NV	NV	na
2-Butanone	4.35E-07	1.04E+03	4.17E-10	no	3.05E-03	8.85E+05	3.45E-09	no
2-Butoxyethanol	NA	2.09E+01		na	NA	NV	NV	na
2-Ethyl-1-hexanol	NA	NV		na	NA	NV	NV	na
2-Furaldehyde	8.44E-07	5.21E+01	1.62E-08	no	1.48E-03	8.00E+03	1.85E-07	no
2-Methyl-1,3-dioxolane	NA	NV		na	NA	NV	NV	na
2-Methyl-1-butene	8.76E-08	NV		na	NA	NV	NV	na
2-Methyl-1-pentene	NA	NV		na	NA	NV	NV	na
2-Methyl-2-butene	NA	NV		na	NA	NV	NV	na
2-Methyl-2-pentene	NA	NV		na	NA	NV	NV	na
2-Methylfuran	NA	NV		na	NA	NV	NV	na
2-Methylheptane	1.25E-08	NV		na	NA	NV	NV	na
2-Methylhexane	1.25E-08	NV		na	NA	NV	NV	na
2-Methylnaphthalene	NA	7.30E+01		na	NA	2.00E+04		na
2-Methylpentane	3.13E-08	NV		na	2.19E-04	1.80E+06	1.22E-10	no
2-Methylpropanal	1.38E-07	NV		na	NA	NV	NV	na
2-Methylpropanenitrile	NA	NV		na	NA	NV	NV	na
2-Nitrophenol	5.57E-08	NV		na	NA	NV	NV	na
2-Pentanone	9.87E-08	NV		na	6.92E-04	8.80E+05	7.86E-10	no
2-Propanol	NA	NV		na	NA	NV	NV	na
3-Ethylhexane	NA	NV		na	NA	NV	NV	na
3-Methyl-1-butene	2.50E-08	NV		na	NA	NV	NV	na
3-Methylhexane	3.13E-08	NV		na	NA	NV	NV	na
3-Methylpentane	3.13E-08	NV		na	NA	NV	NV	na
4-Methyl-1-pentene	NA	NV		na	NA	NV	NV	na
6-Methyl-5-hepten-2-one	NA	NV		na	NA	NV	NV	na

**Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds**

Compound (a)	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HBSL	155mm Illumination Round				> 1?
				> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )	C <sub>acute</sub> /ATV	
Acetic Acid	2.59E-07	NV		na	1.81E-03	3.68E+04	4.93E-08	no
Acetone	3.57E-06	3.65E+02	9.79E-09	no	2.50E-02	2.37E+06	1.06E-08	no
Acetonitrile	7.12E-07	6.21E+01	1.15E-08	no	4.99E-03	1.01E+05	4.95E-08	no
Acetophenone	1.12E-07	2.08E+02	5.40E-06	no	7.88E-04	3.00E+04	2.63E-08	no
Acetylene	7.09E-06	NV		na	NA	NV		na
Acrolein	8.03E-07	2.09E+02	3.85E-05	no	1.41E-03	2.30E+02	6.12E-06	no
Acrylonitrile	2.50E-07	2.83E+02	8.85E-06	no	1.02E-03	2.20E+04	4.64E-08	no
Allylchloride	NA	1.04E+00		na	NA	NV		na
alpha-Pinene	NA	NV		na	NA	NV		na
Benzaldehyde	5.10E-07	3.65E+02	1.40E-09	no	3.57E-03	1.50E+04	2.38E-07	no
Benzene	1.25E-06	2.49E-01	5.02E-06	no	5.11E-03	1.56E+05	3.28E-08	no
Benzene	1.27E-06	2.49E-01	5.11E-06	no	5.20E-03	1.56E+05	3.33E-08	no
Benzofuran	NA	NV		na	NA	NV		na
Benzonitrile	4.26E-07	NV		na	2.99E-03	1.50E+04	1.99E-07	no
Benzylchloride	NA	3.96E-02		na	NA	NV		na
beta-Pinene	NA	NV		na	NA	NV		na
Butanal	9.57E-08	NV		na	6.71E-04	7.38E+04	9.10E-09	no
Carbon Disulfide	1.76E-06	7.30E+02	2.42E-09	no	3.09E-03	3.10E+03	9.97E-07	no
Carbon tetrachloride	1.95E-09	1.28E-01	1.52E-08	no	7.98E-06	1.28E+05	6.23E-11	no
Carbonyl Sulfide	9.63E-08	NV		na	6.75E-04	9.84E+03	6.86E-08	no
Chlorobenzene	NA	6.21E+01		na	NA	NV		na
Chloroethene	NA	2.24E-02		na	NA	NV		na
Chloroform	NA	8.35E-02		na	NA	2.48E+05		na
cis 1,3-Dichloro-1-propene	NA	5.17E-02		na	NA	NV		na
cis-2-Butene	9.70E-08	NV		na	NA	NV		na
cis-2-Hexene	NA	NV		na	NA	NV		na
cis-2-Pentene	2.50E-08	NV		na	NA	NV		na
cis-4-Methyl-2-pentene	NA	NV		na	NA	NV		na
Cyanogen	NA	NV		na	NA	NV		na
Cyclohexane	3.13E-08	NV		na	2.19E-04	3.10E+06	7.08E-11	no
Cyclohexanone	NA	1.83E+04		na	NA	NV		na
Cyclopentane	2.50E-08	NV		na	NA	NV		na
Cyclopentanone	4.67E-06	NV		na	NA	NV		na

**Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds**

Compound (a)	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HBSL	155mm Illumination Round				> 1?
				> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )	C <sub>acute</sub> / ATV	
Cyclopentene	1.13E-07	NV		na	NA	NV	NA	na
Decanal	6.24E-08	NV		na	NA	NV	NA	na
delta-3-Carene	NA	NV		na	NA	NV	NA	na
Dichlorodifluoromethane	4.46E-09	2.09E+02	2.14E-11	no	3.13E-05	1.48E+07	2.11E-12	no
Dichlorotetrafluoroethane	NA	NV		na	NA	NV	NA	na
Dimethyldisulfide	NA	NV		na	NA	NV	NA	na
d-Limonene	NA	NV		na	NA	NV	NA	na
ETBE	NA	NV		na	NA	NV	NA	na
Ethane	1.91E-07	NV		na	NA	NV	NA	na
Ethylbenzene	1.13E-07	1.06E+03	1.06E-10	no	7.90E-04	5.43E+05	1.46E-09	no
Ethylbenzene	1.73E-07	1.06E+03	1.63E-10	no	1.21E-03	5.43E+05	2.23E-09	no
Ethylchloride	NA	2.32E+00	na	na	NA	NV	NA	na
Ethylcyclohexane	NA	NV		na	NA	NV	NA	na
Ethylene	7.77E-06	NV		na	5.44E-02	4.60E+05	1.18E-07	no
Furan	1.30E-07	3.65E+00	3.56E-08	no	9.09E-04	1.67E+02	5.45E-06	no
Heptanal	3.72E-08	NV		na	NA	NV	NA	na
Hexachlorobutadiene	NA	8.73E-02		na	NA	NV	NA	na
Hexanal	2.51E-08	NV		na	NA	NV	NA	na
Hexanenitrile	1.75E-07	NV		na	NA	NV	NA	na
i-Butane	4.07E-08	NV		na	2.85E-04	9.52E+05	2.99E-10	no
i-Butene	6.70E-07	NV		na	4.69E-03	6.87E+06	6.83E-10	no
Indane	NA	NV		na	NA	1.25E+05	NA	na
i-Pentane	3.13E-08	NV		na	NA	NV	NA	na
i-Propylbenzene	NA	4.02E+02		na	NA	NV	NA	na
Isoprene	NA	NV		na	NA	NV	NA	na
<b>m&amp;p-Xylene</b>	1.17E-07	7.30E+02	1.61E-10	no	8.23E-04	6.51E+05	1.26E-09	no
m-Dichlorobenzene	NA	3.29E+00		na	NA	NV	NA	na
Methacrolein	1.40E-07	NV		na	NA	NV	NA	na
Methyl Methacrylate	NA	7.30E+02		na	NA	NV	NA	na
Methylbromide	NA	5.21E+00		na	NA	NV	NA	na
Methylchloride	NA	1.07E+00		na	NA	NV	NA	na
Methylchloroform	NA	1.04E+03		na	NA	1.94E+06	NA	na
Methylcyclohexane	5.63E-08	3.13E+03	1.80E-11	no	3.95E-04	4.81E+06	8.20E-11	no

**Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds**

Compound (a)	C <sub>chronic</sub> (µg/m <sup>3</sup> )	155mm Illumination Round					
		Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HB <sub>SL</sub>	> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )	C <sub>acute</sub> /ATV
Methylcyclopentane	1.88E-08	NV			NA	NV	na
Methylenechloride	1.89E-05	4.09E+00	4.63E-06	no	7.74E-02	6.96E+05	1.11E-07
Methylnitrite	3.09E-07	NV			NA	NV	na
m-Ethyltoluene	3.76E-08	NV			NA	NV	na
Methyl-vinyl Ketone	8.92E-08	NV			NA	6.25E-04	8.61E+01
<b>MTBE</b>	0.00E+00	3.13E+03	0.00E+00	no	0.00E+00	4.32E+05	0.00E+00
<b>MTBE</b>	5.78E-09	3.13E+03	1.85E-12	no	4.05E-05	4.32E+05	9.38E-11
m-Xylene & p-Xylene	1.19E-07	7.30E+02	1.63E-10	no	8.33E-04	6.51E+05	1.28E-09
Naphthalene	5.88E-07	3.13E+00	1.88E-07	no	4.12E-03	7.86E+04	5.24E-08
n-Butane	2.00E-07	NV			NA	NV	na
n-Decane	2.50E-08	NV			NA	1.75E-04	4.37E+03
n-Heptane	5.01E-08	NV			NA	3.51E-04	4.02E-08
n-Hexane	7.20E-08	2.09E+02	3.45E-10	no	5.04E-04	5.28E+05	9.55E-10
Nitromethane	3.19E-07	NV			NA	2.23E-03	1.50E+05
n-Nonane	3.76E-08	NV			NA	2.63E-04	1.05E+06
n-Octane	3.13E-08	NV			NA	NV	na
Nonanal	4.32E-08	NV			NA	NV	na
n-Pentane	6.88E-08	NV			NA	4.82E-04	1.80E+06
n-Propylbenzene	3.44E-08	3.65E+01	9.43E-10	no	2.41E-04	3.68E+05	6.55E-10
Octanal	3.30E-08	NV			NA	NV	na
o-Dichlorobenzene	NA	2.09E+02			NA	NV	na
o-Ethyltoluene	3.76E-08	NV			NA	2.63E-04	7.50E+02
o-Xylene	1.22E-07	7.30E+02	1.67E-10	no	8.55E-04	6.51E+05	1.31E-09
<b>o-Xylene</b>	1.24E-07	7.30E+02	1.70E-10	no	8.70E-04	6.51E+05	1.34E-09
p-Dichlorobenzene	NA	2.80E-01			NA	NV	na
Pentanal	2.08E-07	NV			NA	NV	na
Pentanenitrile	1.48E-07	NV			NA	NV	na
Perchloroethylene	NA	3.31E+00			NA	6.89E+05	na
p-Ethyltoluene	1.94E-07	NV			NA	1.36E-03	1.25E+05
<b>p-Ethyltoluene</b>	3.06E-08	NV			NA	2.14E-04	1.25E+05
Phenylacetylene	1.44E-07	NV			NA	NV	na
Propane	1.04E-06	NV			NA	7.30E-03	3.78E+06
Propanenitrile	1.34E-07	NV			NA	9.40E-04	3.38E+04

**Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds**

Compound (a)	155mm Illumination Round						$C_{acute} / ATV$	$> 1?$
	$C_{chronic}$ ( $\mu\text{g}/\text{m}^3$ )	Health-Based Screening Level ( $\mu\text{g}/\text{m}^3$ )	$C_{chronic} / HBSL$	$> 1?$	$C_{acute}$ ( $\mu\text{g}/\text{m}^3$ )	Acute Toxicity Value ( $\mu\text{g}/\text{m}^3$ )		
Propene	1.18E-06	NV		na	na	NV		na
Styrene	NA	1.06E+03		na	na	2.13E+05		na
<b>Styrene</b>	NA	1.06E+03		na	na	2.13E+05		na
Tetrahydrofuran	1.53E-08	9.89E-01	1.54E-08	no	NA	NV		na
Thiophene	8.27E-08	NV		na	NA	NV		na
Toluene	6.63E-07	4.02E+02	1.65E-09	no	1.16E-03	1.88E+05	6.20E-09	no
<b>Toluene</b>	6.75E-07	4.02E+02	1.68E-09	no	1.18E-03	1.88E+05	6.31E-09	no
trans 1,3-Dichloro-1-propene	NA	NV		na	NA	NV		na
trans-2-Butenal	3.95E-08	3.54E-03	1.12E-05	no	NA	NV		na
trans-2-Butene	2.32E-07	NV		na	NA	NV		na
trans-2-Hexene	NA	NV		na	NA	NV		na
trans-2-Pentene	3.44E-08	NV		na	NA	NV		na
Trichloroethylene	NA	1.12E+00		na	NA	NV		na
Trichloromonomethylmethane	7.23E-10	7.30E+02	9.91E-13	no	NA	NV		na
Vinylidenechloride	NA	3.84E-02		na	NA	NV		na

Footnotes:

(a) Items in bold represent duplicate values for those compounds that are common for Method TO-14 and TO-12.

NA = Not applicable

na = Not available because health-based screening value is not available or not applicable because compound was not detected.

NV = No value

$C_{chronic}$  = Chronic time-averaged concentration

HBSL = Chronic health-based screening level

$C_{acute}$  = Acute concentration

ATV = Acute toxicity value

**Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds**

Compound	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HBSL	155mm Illumination Round			C <sub>acute</sub> / ATV	> 1?
				> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )		
1,2,4,5-Tetrachlorobenzene	NA	1.10E+00	NA	NA	NA	NV	NA	na
1,2,4-Trichlorobenzene	NA	2.08E+02	NA	NA	NA	NV	NA	na
1,2-Dichlorobenzene	NA	2.09E+02	NA	NA	NA	NV	NA	na
1,3-Dichlorobenzene	NA	3.29E+00	NA	NA	NA	NV	NA	na
1,3-Dinitrobenzene	NA	3.65E-01	NA	NA	NA	NV	NA	na
1,4-Dichlorobenzene	NA	3.06E-01	NA	NA	NA	NV	NA	na
1,4-Naphthoquinone	NA	NV	NA	NA	NA	NV	NA	na
1-Naphthylamine	NA	NV	NA	NA	NA	NV	NA	na
2,3,4,6-Tetrachlorophenol	NA	1.10E+02	NA	NA	NA	NV	NA	na
2,4,5-Trichlorophenol	NA	3.65E+02	NA	NA	NA	NV	NA	na
2,4,6-Trichlorophenol	NA	6.20E-01	NA	NA	NA	NV	NA	na
2,4-Dichlorophenol	NA	1.10E+01	NA	NA	NA	NV	NA	na
2,4-Dimethylphenol	NA	7.30E+01	NA	NA	NA	NV	NA	na
2,4-Dinitrophenol	NA	7.30E+00	NA	NA	NA	NV	NA	na
2,4-Dinitrotoluene	NA	7.30E+00	NA	NA	NA	NV	NA	na
2,6-Dichlorophenol	NA	NV	NA	NA	NA	NV	NA	na
2,6-Dinitrotoluene	NA	3.65E+00	NA	NA	NA	NV	NA	na
2-Acetylaminofluorene	NA	NV	NA	NA	NA	NV	NA	na
2-Chloronaphthalene	NA	2.92E+02	NA	NA	NA	NV	NA	na
2-Chlorophenol	NA	1.83E+01	NA	NA	NA	NV	NA	na
2-Methylnaphthalene	NA	7.30E+01	NA	NA	NA	NV	2.00E+04	na
2-Methylphenol	NA	1.83E+02	NA	NA	NA	NV	NA	na
2-Naphthylamine	NA	NV	NA	NA	NA	NV	NA	na
2-Nitroaniline	NA	2.09E-01	NA	NA	NA	NV	NA	na
2-Nitrophenol	NA	NV	NA	NA	NA	NV	NA	na
2-Picoline	NA	NV	NA	NA	NA	NV	NA	na
3,3'-Dichlorobenzidine	NA	1.49E-02	NA	NA	NA	NV	NA	na
3,3'-Dimethylbenzidine	NA	7.31E-04	NA	NA	NA	NV	NA	na
3-Methylcholanthrene	NA	NV	NA	NA	NA	NV	NA	na
3-Nitroaniline	NA	NV	NA	NA	NA	NV	NA	na
4,6-Dinitro-2-methylphenol	NA	3.65E-01	NA	NA	NA	NV	NA	na
4-Aminobiphenyl	NA	NV	NA	NA	NA	NV	NA	na
4-Bromophenylphenyl ether	NA	NV	NA	NA	NA	NV	NA	na

**Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds**

Compound	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	155mm Illumination Round			
			C <sub>chronic</sub> /HBSL	> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )
4-Chloro-3-methylphenol	NA	NV		na	NA	NV
4-Chlorophenylphenyl ether	NA	NV		na	NA	NV
4-Methylphenol/3-Methylphenol	NA	1.83E+01		na	NA	NV
4-Nitroaniline	NA	NV		na	NA	NV
4-Nitrophenol	NA	2.92E+01		na	NA	NV
4-Nitroquinoline-1-oxide	NA	NV		na	NA	NV
5-Nitro-o-toluidine	NA	NV		na	NA	NV
7,12-Dimethylbenz(a)anthracene	NA	NV		na	NA	NV
Acenaphthene	NA	2.19E+02		na	NA	NV
Aceraphthylene	NA	NV		na	NA	NV
Acetophenone	1.67E-07	2.08E-02	8.00E-06	no	1.17E-03	3.00E+04
Aniline	NA	1.04E+00		na	NA	3.90E-08
Anthracene	NA	1.10E+03		na	NA	2.29E+04
Benz(a)anthracene	NA	2.17E-02		na	NA	NV
Benz(a)pyrene	NA	2.17E-03		na	NA	NV
Benzidine	NA	2.92E-05		na	NA	NV
Benzo(b)fluoranthene	NA	2.17E-02		na	NA	NV
Benzog(h,)perylene	NA	NV		na	NA	NV
Benzo(k)fluoranthene	NA	2.17E-01		na	NA	NV
Benzoic acid	NA	1.46E+04		na	NA	NV
Benzyl alcohol	NA	1.10E+03		na	NA	5.53E+04
bis(2-Chloroethoxy)methane	NA	NV		na	NA	NV
bis(2-Chloroethyl)ether	NA	5.82E-03		na	NA	NV
bis(2-Chloroisopropyl)ether	NA	1.92E-01		na	NA	NV
bis(2-Ethylhexyl)phthalate	NA	4.80E-01		na	NA	NV
Butylbenzylphthalate	1.89E-07	7.30E+02	2.59E-10	no	1.32E-03	5.00E+05
Carbazole	NA	3.36E-01		na	NA	NV
Chlorobenzilate	NA	2.49E-02		na	NA	NV
Chrysene	NA	2.17E+00		na	NA	NV
Diallate	NA	1.10E-01		na	NA	NV
Dibenz(a,h)anthracene	NA	2.17E-03		na	NA	NV
Dibenzofuran	NA	1.46E+01		na	NA	NV
Diethylphthalate	1.02E-07	2.92E+03	3.50E-11	no	7.16E-04	1.50E+04
						4.77E-08
						no

**Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds**

Compound	155mm Illumination Round						> 1?	C <sub>acute</sub> / ATV	> 1?
	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HBSL	> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )			
Dimethylphenethylamine	NA	3.65E+00		na	NA	NV			na
Dimethylphthalate	NA	3.65E+04		na	NA	NV			na
Di-n-butylphthalate	2.06E-07	3.65E+02	5.65E-10	no	1.45E-03	1.50E+04	9.64E-08	no	na
Di-n-octylphthalate	NA	7.30E+01		na	NA	1.50E+05			na
Diphenylamine/N-NitrosoDPA	NA	9.13E+01		na	NA	NV			na
Ethyl methanesulfonate	NA	NV		na	NA	NV			na
Fluoranthene	NA	1.46E+02		na	NA	NV			na
Fluorene	NA	1.46E+02		na	NA	7.50E+04			na
Hexachlorobenzene	NA	4.18E-03		na	NA	NV			na
Hexachlorobutadiene	NA	8.62E-02		na	NA	NV			na
Hexachlorocyclopentadiene	NA	7.30E-02		na	NA	NV			na
Hexachloroethane	NA	4.80E-01		na	NA	NV			na
Hexachloropropene	NA	NV		na	NA	NV			na
Indeno(1,2,3-cd)pyrene	NA	2.17E-02		na	NA	NV			na
Isophorone	NA	7.08E+00		ra	NA	NV			na
Isosafrole	NA	NV		ra	NA	NV			na
Kepone	NA	3.74E-04		ra	NA	NV			na
Methaphyline	NA	NV		ra	NA	NV			na
Methyl methanesulfonate	NA	NV		ra	NA	NV			na
Naphthalene	3.48E-07	3.13E+00	1.11E-07	no	2.44E-03	7.86E+04	3.10E-08	no	na
Nitrobenzene	NA	2.09E+00		ra	NA	NV			na
N-Nitrosodiethylamine	NA	4.47E-05		ra	NA	NV			na
N-Nitrosodimethylamine	NA	4.47E-05		ra	NA	NV			na
N-Nitroso-di-n-butylamine	NA	1.20E-03		ra	NA	NV			na
N-Nitroso-di-n-propylamine	NA	9.61E-04		ra	NA	NV			na
N-Nitrosomethyltetrahydronaphthalene	NA	3.06E-04		ra	NA	NV			na
N-Nitrosomorpholine	NA	NV		ra	NA	NV			na
N-Nitrosopiperidine	NA	NV		ra	NA	NV			na
N-Nitrosopyrrolidine	NA	3.15E-03		ra	NA	NV			na
o-Toluidine	NA	2.80E-02		ra	NA	NV			na
p-Chloroaniline	NA	1.46E+01		ra	NA	NV			na
p-Dimethylaminoazobenzene	NA	NV		na	NA	NV			na
Pentachlorobenzene	NA	2.92E+00		na	NA	NV			na

**Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds**

Compound	C <sub>chronic</sub> (µg/m <sup>3</sup> )	Health-Based Screening Level (µg/m <sup>3</sup> )	C <sub>chronic</sub> /HBSL	155mm Illumination Round				
				> 1?	C <sub>acute</sub> (µg/m <sup>3</sup> )	Acute Toxicity Value (µg/m <sup>3</sup> )	C <sub>acute</sub> /ATV	> 1?
Pentachloroethane	NA	NV		na	NA	NV		na
Pentachloronitrobenzene	NA	2.59E-02		na	NA	NV		na
Pentachlorophenol	NA	5.60E-02		na	NA	NV		na
Phenacetin	NA	NV		na	NA	NV		na
Phenanthrene	NA	NV		na	NA	NV		na
Phenol	NA	2.19E+03		na	NA	2.00E+03		na
Pronamide	NA	2.74E+02		na	NA	NV		na
Pyrene	NA	NV		na	NA	NV		na
Pyridine	NA	3.65E+00		na	NA	NV		na
Safrole	NA	NV		na	NA	NV		na
sym-Trinitrobenzene	NA	1.10E+02		na	NA	NV		na

Footnotes:

NA = Not applicable

na = Not available because health-based screening value is not available or not applicable because compound was not detected.

NV = No value

C<sub>chronic</sub> = Chronic time-averaged concentration

HBSL = Chronic health-based screening level

C<sub>acute</sub> = Acute concentration

ATV = Acute toxicity value

**Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons**

Compound (a)	155mm Illumination Round				Aromatic:C>8
	C <sub>chronic</sub> (µg/m <sup>3</sup> )				
<b>1,2,4-Trimethylbenzene</b>	NA	NA	NA	NA	2.88E-08
<b>1,2,4-Trimethylbenzene &amp; sec-Butylbenzene</b>	NA	NA	NA	NA	2.03E-07
1-Butene	5.48E-07	NA	NA	NA	NA
1-Hexene	3.10E-07	NA	NA	NA	NA
1-Pentene	2.19E-07	NA	NA	NA	NA
<b>2,2,4-Trimethylhexane</b>	NA	5.01E-08	NA	NA	NA
<b>2,2,4-Trimethylpentane</b>	1.13E-07	NA	NA	NA	NA
<b>2,3,4-Trimethylpentane</b>	9.39E-09	NA	NA	NA	NA
<b>2,3-Dimethylpentane</b>	1.25E-08	NA	NA	NA	NA
<b>2,4-Dimethylhexane</b>	2.19E-08	NA	NA	NA	NA
<b>2,4-Dimethylpentane</b>	1.56E-08	NA	NA	NA	NA
<b>2,5-Dimethylhexane</b>	9.39E-09	NA	NA	NA	NA
<b>2-Methyl-1-butene</b>	8.76E-08	NA	NA	NA	NA
<b>2-Methylheptane</b>	1.25E-08	NA	NA	NA	NA
<b>2-Methylhexane</b>	1.25E-08	NA	NA	NA	NA
<b>2-Methylpentane</b>	3.13E-08	NA	NA	NA	NA
<b>3-Methyl-1-butene</b>	2.50E-08	NA	NA	NA	NA
<b>3-Methylhexane</b>	3.13E-08	NA	NA	NA	NA
<b>3-Methylpentane</b>	3.13E-08	NA	NA	NA	NA
<b>Benzene</b>	NA	NA	2.92E-06	NA	NA
<b>Benzene</b>	NA	NA	2.97E-06	NA	NA
<b>cis-2-Butene</b>	9.70E-08	NA	NA	NA	NA
<b>cis-2-Pentene</b>	2.50E-08	NA	NA	NA	NA
<b>Cyclohexane</b>	3.13E-08	NA	NA	NA	NA
<b>Cyclopentane</b>	2.50E-08	NA	NA	NA	NA
<b>Cyclopentene</b>	1.13E-07	NA	NA	NA	NA
<b>Ethylbenzene</b>	NA	NA	1.13E-07	NA	NA
<b>Ethylbenzene</b>	NA	NA	1.73E-07	NA	NA
<b>i-Butane</b>	4.07E-08	NA	NA	NA	NA
<b>i-Butene</b>	6.70E-07	NA	NA	NA	NA
<b>i-Pentane</b>	3.13E-08	NA	NA	NA	NA

**Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons**

Compound (a)	155mm Illumination Round			
	$C_{\text{chronic}} (\mu\text{g}/\text{m}^3)$	$C_{\text{chronic}} (\mu\text{g}/\text{m}^3)$	$C_{\text{chronic}} (\mu\text{g}/\text{m}^3)$	$C_{\text{chronic}} (\mu\text{g}/\text{m}^3)$
<b>m&amp;p-Xylene</b>	<b>NA</b>	<b>NA</b>	<b>1.17E-07</b>	<b>Aromatic:C&gt;8</b>
Methylcyclohexane	5.63E-08	NA	NA	NA
<b>Methylcyclopentane</b>	<b>1.88E-08</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>
<b>m-Xylene &amp; p-Xylene</b>	<b>NA</b>	<b>NA</b>	<b>1.19E-07</b>	<b>NA</b>
<b>n-Butane</b>	<b>2.00E-07</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>
n-Decane	NA	2.50E-08	NA	NA
n-Heptane	5.01E-08	NA	NA	NA
n-Hexane	7.20E-08	NA	NA	NA
n-Nonane	NA	3.76E-08	NA	NA
n-Octane	3.13E-08	NA	NA	NA
n-Pentane	6.88E-08	NA	NA	NA
n-Propylbenzene	NA	NA	NA	3.44E-08
<b>o-Xylene</b>	<b>NA</b>	<b>NA</b>	<b>1.22E-07</b>	<b>NA</b>
<b>o-Xylene</b>	<b>NA</b>	<b>NA</b>	<b>1.24E-07</b>	<b>NA</b>
Propane	1.04E-06	NA	NA	NA
<b>Toluene</b>	<b>NA</b>	<b>NA</b>	<b>6.63E-07</b>	<b>NA</b>
<b>Toluene</b>	<b>NA</b>	<b>NA</b>	<b>6.75E-07</b>	<b>NA</b>
<b>trans-2-Butene</b>	<b>2.32E-07</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>
<b>trans-2-Pentene</b>	<b>3.44E-08</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>
<b>Total</b> ( $\mu\text{g}/\text{m}^3$ )	<b>4.19E-06</b>	<b>1.13E-07</b>	<b>4.06E-06</b>	<b>2.38E-07</b>
<b>Derived Health-Based Screening Level</b>	<b>1.92E+04</b>	<b>1.04E+03</b>	<b>4.17E+02</b>	<b>2.09E+02</b>
$C_{\text{chronic}}/\text{HBSL}$	<b>2.18E-10</b>	<b>1.08E-10</b>	<b>9.73E-09</b>	<b>1.14E-09</b>
$>1?$	no	no	no	no

Footnotes:

(a) Items in bold represent duplicate values: highest concentration was used to estimate total petroleum hydrocarbon concentration

$>1?$  = Is the ratio greater than one?

NA = Not Applicable because compound was not detected

$C_{\text{chronic}}$  = Chronic averaged air Concentration

HBSL = Health-Based Screening Level

## **APPENDIX E**

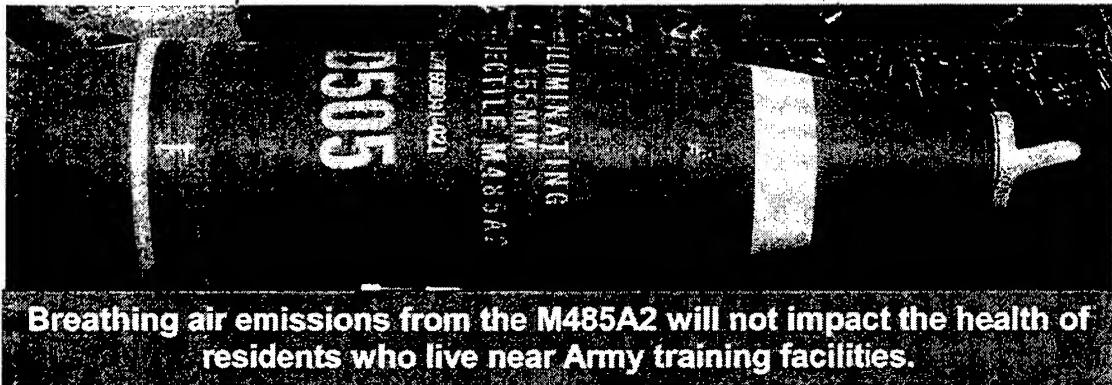
### **FACT SHEET SUBMITTED TO AEC**

# United States Army Environmental Center

## Pyrotechnics Fact Sheet

### ***M485A2 155 mm Illumination Round***

Department of Defense Identification Code: D505



**Breathing air emissions from the M485A2 will not impact the health of residents who live near Army training facilities.**

### **WHAT ARE PYROTECHNICS?**

The terms pyrotechnics and fireworks are often used interchangeably. Pyrotechnics give off smoke, light, and/or a loud noise when activated. The military uses pyrotechnics for signaling, obscuring, and illuminating during training and combat.

### **WHAT IS THE M485A2?**

The M485A2 is a type of pyrotechnic device used mainly to warn our service men and women of infiltrating troops by lighting up the field. The M485A2 is a relatively large pyrotechnic device, weighing about 93 pounds.

### **HOW IS THE M485A2 USED?**

The M485A2 is fired from a 155 mm howitzer, a cannon used for firing projectiles to high elevations. A propellant charge carries the round to a height of about 1800 feet. Then, the illumination charge activates, creating a bright light that lasts for about two

minutes. The parachute activates, and the round falls to the ground.

### **WHERE IS THE M485A2 USED?**

Many Army training events use the M485A2. Nearly every Army training installation holds these events. At most locations, the training areas are at least 1000 meters (over half a mile) away from populated areas. In general, about three M485A2 rounds are used during each training event. About five training events are typically conducted each year at a given training facility.

Use of the M485A2 illumination round is very important in training exercises because it allows our service men and women to prepare for real life situations.

### **WHAT IS IN THE M485A2?**

The M485A2 contains a pyrotechnic charge that provides the bright light. This mixture is made up mostly of sodium nitrate and magnesium powder. The round also contains a propelling

agent made up of potassium nitrate, charcoal, and sulfur.

## **WILL BREATHING AIR EMISSIONS FROM THE M485A2 AFFECT MY HEALTH?**

To answer this question, the U.S. Army Environmental Center tested the air emissions from the M485A2. The U.S. Army Center for Health Promotion and Preventive Medicine then determined if there would be a potential for health effects from inhalation to residents living near training areas. Study results showed that residents breathing air as close as 100 meters (328 feet) from the activation site are safe from these emissions.

## **HOW WAS THE STUDY DONE?**

To gather data for the study, airborne emissions data was collected by activating the M485A2 in a test chamber. The air in the chamber was tested to identify the types and amounts of substances released. More than 300 substances were looked for during this part of the study.

This information was then used in an air model (a computer program that allows estimation of air concentrations) to determine the amount of each substance, to which someone living near a training site might be exposed. Downwind concentrations were estimated based on a typical use scenario for the M485A2. Since the study does not look at a specific training

area, the assumptions used in the model will in most cases, predict higher downwind air concentrations than those expected at an actual training site.

These estimated air concentrations were then compared to safe screening levels established by the U.S. Environmental Protection Agency and other agencies. If the air concentrations are below these screening levels, they are considered safe for everyone, including sensitive people such as the sick, elderly, and children.

## **WHAT ARE THE STUDY LIMITATIONS?**

Many steps were taken to ensure that the results of this study are protective of everyone who lives close to training areas. However, limitations do exist with this study. For example, the study does not consider exposure to other types of munitions that could also be used during the same training event. Due to these limitations, conservative model conditions were used to ensure the protection of public health from inhalation of the M485A2 air emissions.

## **WHERE CAN I GET MORE INFORMATION?**

For more information on the M485A2 and other military munitions, call the Army Environmental Center Hotline at 1-800-USA-3845, visit our website at [www.aec.army.mil](http://www.aec.army.mil), or email to [t2hotline@aec.apgea.army.mil](mailto:t2hotline@aec.apgea.army.mil).